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Electrical Review

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THE NORTHWESTERN CONVENTION.

Of all the various electrical associations which meet from time to time in conventions, none seems to have more vigorous life and to be of more interest and benefit to its members than the Northwestern Electrical Association, whose Summer convention at Waupaca, Wis., is described in other pages of this issue. This convention was peculiarly successful and very well attended, perhaps, in some measure, on account of the character of the surroundings in which it was held. In Summer time the lake region of Wisconsin is little short of an earthly paradise. Much wisdom was shown in the arrangement of the programme and the inclusion in it of pleasant excursions and other features which made the Waupaca meeting so delightful. The serious work of the convention, though, in the reading and discussion of papers amply repaid those who attended its sessions. The papers were of a high class of excellence this year, and the discussions, as may well be seen from the report, were of the "experience-meeting" kind in which everybody present took part and told what he knew about the subject in hand. It is just this kind of discussion that is the most useful, most interesting, most valuable and productive of the best results. The Northwestern Association is much to be congratulated upon its ability to bring out at its meetings these interesting expressions from its members.

ELECTRIC CAR HEATING.

It seems a curious time of the year to discuss the subject of heating electric railway cars, but this is the season when repairs and alterations in the electrical heating system will be made, and street railway managers will begin to think about next Winter and the conditions they will then have to encounter. The load imposed upon the generating plant of a street railway by electric heating in the cars is by no means inconsiderable. At the time of maximum travel it may amount to a very serious burden upon the plant. A suggestion has been made by one of our British contemporaries which seems to be of great value. It is to install a simple device to connect electric heaters in the car with the controller, so that the heaters will be cut out on the last two notches of speed; in other words, when the car is taking its maximum power the heaters will be for the moment cut off and will take none. It certainly seems as if this simple method, which would introduce no great complexity, should be sufficiently important to enlist the attention of street railway engineers. An admirable field for its trial will be furnished by the equipments of the elevated railroads of New York city, and of the Rapid Transit Subway which is to be built within the next five years.

ARTIFICIAL DIAMONDS.

In an interesting article by Mr. F. M. Perkin on another page of this issue is described and illustrated Majorana's experiments for the manufacture of diamonds by artificial means. Electricity is used to produce a very high temperature, and the explosive force of gunpowder to subject the heated carbon to a very high pressure. Of course upon the laboratory scale of work the diamonds manufactured are very small and cost very much more than natural crystals of the same size would have cost. Nevertheless, it is extremely interesting to think of the possibility of utilizing the electric furnace to make diamonds, and to wonder what the effect of such a manufacturing industry would be upon the fashion of jewels and the shares of the mining companies. At the moment of writing, however, no alarm is felt, either by those who own diamonds or those who mine them.

MAIN LINE ELECTRIC RAILROADS.

With each succeeding year we approach nearer to the final electrification of the main line railway, and to-day we are very close to the happy era when the steam locomotive shall be no more in the thickly-inhabited section of cities. It has been everywhere a tendency of population in this country to gather itself in large centres, and, as if by a reaction, subsequently to tend to spread into the region surrounding those centres, and while increasing in numerical total to decrease in density in city areas. In other words, the great suburban movement has begun, and this has called for classes of transit unknown twenty years ago and has made demands upon all varieties of engineering for its improvement and perfection. It is still far from perfect.

In all quarters where great centres of population exist we hear accounts of the change of existing steam railways serving this suburban travel into electric railways. During the next year a large and important installation of medium-class railways is to be made in New York city and its adjacent neighborhoods. This variety of work can only be considered as a step in the direction of electric power for heavy railway uses.

The question of motive power for a railway, alone and uncomplicated with other considerations, resolves itself into a purely economical problem. It is not difficult to calculate with great exactness what it will cost to equip a certain line of railroad with electricity, and what it will cost to operate it afterward. In any given instance a comparison between this cost and that for steam locomotives may be made, but even as a basis for argument it is scarcely worth making. The reason for this statement is that the mere cost of motive power is by no means the largest factor in determining the choice of an electric system. It will probably be hard to convince railroad superintendents and presidents that a more expensive power might be advantageous, or that a change in equipment involving the expenditure of a large amount of money would produce an entirely new and highly profitable condition of affairs as regards passenger traffic; yet one has only to look around and see what has already been done to gather an idea of what it is possible to do in the same direction. It is not possible to know the magnitude of the future of the electric railway, as everyone may realize who will think back ten years ago and consider the derision with which he would then have met a plain statement of the growth of the electric railway in the decade now ending.

Looking at the problem, then, of long-distance railroading by electricity, one sees that the engineering questions involved are few and comparatively simple. It is obvious that alternating current in some of its various forms must be employed; consequently the choice of a system lies between a purely polyphase system and a substation system feeding direct current to the track conductors. The substation in which rotary converters are installed necessarily involves an increase in the labor cost. It is probable, considering everything, that some form of polyphase distribution using induction motors on the trains would be simplest, for its whole conducting and distributing system from power house to moving trains would not require further supervision than that necessary for the maintenance in good order of outdoor equipment. So far, experiments with railway motors of this kind have been confined to Switzerland and Italy, but the results have been promising. For long-distance work, the main difficulties that have been urged against these machines are of small importance. The question of stopping and starting is not so important on these long lines as that of keeping moving at a uniform speed. The conducting system necessary, if the track is included as an element of it, will naturally consist of at least two elements for three-phase work, which is the simplest that can be conceived. While some additional complexity in switches and yards will be introduced by this doubling of the conducting system it will not be of a sort to cause serious difficulty. It should not be beyond the inventive ability of those who have done such admirable work in the perfection of the electric railway as it now exists.

No one can foresee the economic results that will follow from a change in the method of railway operation such as can be made alone through the agency of electric power. It would have been impossible to foresee ten years ago the immense increase of business that has followed the electrical equipment of comparatively short interurban lines. In one well-known case the traffic on such a line has increased eleven-fold in two years since the adoption of electricity in place of the steam locomotive, the reason being that trains are more frequent, rates of fare are lower, rates of speed are actually higher, and the pleasure and convenience of travel are much increased. It should be borne in mind that great increases of speed are not really necessary. The average railway journey can be accomplished within a day, which means, for the average traveler, within a night. Between New York and Boston, for example, it is useless to attempt to reduce the time of night trains below seven hours, because the passengers sleep on the train and the reduction would be of no benefit to them. High speeds are not the desideratum; what is wanted is uniform speed, light trains, freedom from dirt, cinders and dust and the flexibility of electric service which will permit as many and as frequent trains to be operated as the exigencies of travel may require. In the direction of the application of electric traction with its manifold advantages to the main line railway lies the greatest opportunity now before the electrical inventor and engineer.

The one spark of comfort that can be caught from the dreadful conflagration at Hoboken last week, in which the wharves and ships of the North-German Lloyd Steamship Line were destroyed with great loss of life, is that no one has claimed it to have been an electrical fire. It is fashionable just now to lay the blame of every fire of mysterious origin to "electric wires." People have been educated to think of electrical conductors as menacing and incendiary things, and of electricity as the great fire setter. Precisely the opposite view is correct. While some fires have been due to electrical causes, how many thousands of others have been promptly extinguished after an electric alarm?

A LONG HIGH-SPEED ELECTRIC RAILWAY.

THE DETROIT, YPSILANTI & ANN ARBOR ELECTRIC RAILWAY—A HIGH-CLASS EXAMPLE OF INTERURBAN LIGHT TRAFFIC ELECTRIC LINE.

The equipment of the Detroit, Ypsilanti & Ann Arbor Electric Railway by electricity has been an object lesson of the first importance to small railways elsewhere in the United States, and has clearly shown the importance of particular operative methods which can only be obtained by the use of electric traction. When the company was organized, three years ago, it was determined from the outset that only excellent types of machinery and equipment should be used, that every detail should be completed in the most reliable manner possible, and that a policy of great liberality toward the public should be inaugurated. The result of the first year's operation shows the wisdom of this broad-minded policy, as a valuable freight and passenger traffic has been developed, and the property is already earning dividends for its stockholders.

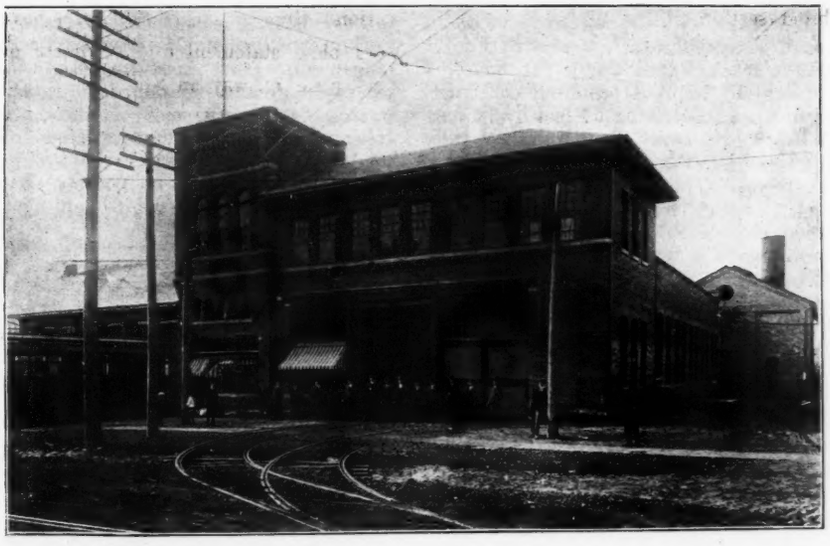


FIG. 1.—THE DETROIT, YPSILANTI & ANN ARBOR RAILWAY'S CAR BARNS AND OFFICES AT YPSILANTI, MICH.

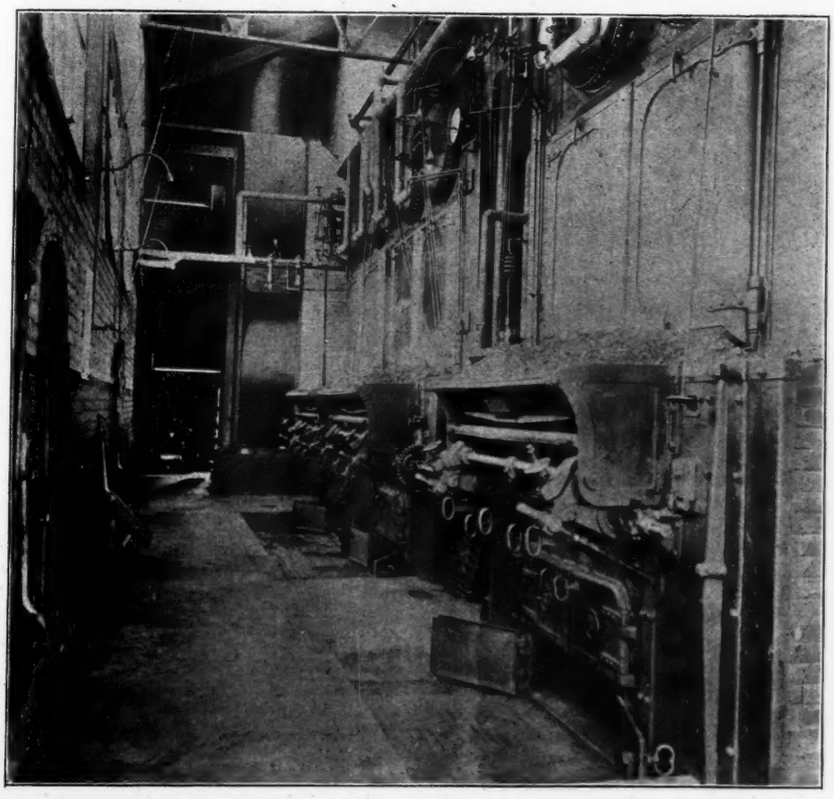


FIG 2.—THE DETROIT, YPSILANTI & ANN ARBOR RAILWAY. BOILER-ROOM WITH STOKERS AND INDUCED DRAFT.

The length of the track is 50 miles. The main line from Detroit, passing through Wayne and Ypsilanti to Ann Arbor, is 40 miles, and a branch from Ypsilanti to Saline is 10 miles in length. From the City Hall, in the centre of Detroit, cars pass down Michigan avenue for six miles, using the tracks of the Citizens' Street Railway Company. From the city limits a new track was laid through Dearborn and Wayne to Ypsilanti, and thence to Ann Arbor. The franchise of the former railway from Ypsilanti to Ann Arbor, and of five miles of track in Ann Arbor city were acquired by purchase and entirely rebuilt and reequipped. The Saline division is a new construction.

The route passes through a rich agricultural country and through several thriving towns and cities, from which local and through traffic is drawn. Dearborn, 10 miles from Detroit, has about 1,000 inhabitants. Inkster and Eloise are smaller places. Wayne, 20 miles from Detroit, is the junction of the Plymouth & Northfield Electric Railway. Canton and Denton are passed through before reaching Ypsilanti, a manufacturing city of 4,000 inhabitants. In addition to the ordinary population of Ypsilanti the State Normal School has from 2,000 to 3,000 students. Ann Arbor, the terminus of the line, has a population of 15,000 inhabitants; it is the seat of the University of Michigan.

The plans for the complete engineering equipment of this railway were prepared by Westinghouse, Church, Kerr & Company, New York, and to the Detroit office of the same company was awarded the contract for furnishing the steam and electrical machinery for the two power houses, and the motors and air brakes for the cars. The promoters of the railway stipulated for the most advanced type of machinery and the introduction of the latest mechanical devices for securing economy in operation. It is no secret that the engineers were given a free hand, and the contract was in the nature of a confidential one. This latitude has been justified, for the installation is a model in all respects, embodying great simplicity yet completeness of design, and is an excellent illustration of economical practice where direct-current electricity is solely used for operating a railroad of considerable length.

Two power houses have been erected 19 miles apart, one at Ypsilanti, 10 miles from the Ann Arbor terminus, and the other at Dearborn, five miles from the Detroit city limits. The equipment of both power houses is very similar, differing only in the feeders and in boiler-feeding apparatus. A description of the Ypsilanti plant will therefore suffice for both.

The power house and car barns are attractive buildings and present a pleasing appearance from the main road entering Ypsilanti from the east. They adjoin the Huron River, which affords an abundant supply of water for boilers and condensers at all seasons of the year. Facing the high road are the extensive car barns and repair shops, with the company's offices in front, a view of which is seen in Fig. 1. At the back stands the power house, a substantial fireproof building, constructed of brick, measuring 67 feet by 72 feet. A heavy brick wall about equally divides the space between the boiler and generating rooms. The appearance of the interior of the generating room is very attractive, it being lofty, well lighted and ventilated. A few palms add greatly to the cheerfulness, and emphasize the neatness of the surroundings. The foundations are of concrete, the floors being cemented throughout.

The equipment of the steam plant, shown in Fig. 2, includes the latest improvements and secures the utmost economy in operation. Three water-tube boilers, rated at 225 horse-power each, carrying a steam pressure of 150 pounds, are equipped with Roney mechanical stokers, which afford complete combustion of the fuel and enable the cheapest grades of coal to be burned with minimum labor in firing. Ohio slack coal, costing $1.45 a ton, delivered at the railway, is used. Reference to Fig. 1 shows the stack, which extends only a few feet above the roof of the building. A section of the power house is shown in Fig. 3.

The Westinghouse system of economizer mechanical draft has been introduced, with two vertical fans driven by an eight horse-power steam engine. The speed of the engines, and therefore that of the fans, is controlled by quick acting regulators, so that as the steam pressure begins to rise upon the boilers, a valve reduces the supply of steam to the fan engine. By this automatic arrangement the amount of the mechanical draft is regulated by the pressure in the boilers, as an increase of boiler pressure slows down the engine driving the fans. By combining fuel economizers with the mechanical draft, low waste-gas temperatures are secured and the heat is returned to the feed water, making a saving in itself without excessive cost or complication.

The water for feeding the boilers and for the condensers is obtained from the Huron River, which runs alongside the power house. A crib has been carried out several feet, projecting into the river, into which the water passes, and from which it flows, by an 18-inch pipe, to a well 14 feet deep. Feed water for the boilers is pumped from the well through a four-inch pipe by two Worthington outside packed pumps, each sufficient to care for the whole plant. The feed water passes through an exhaust heater, utilizing exhaust steam from pumps, condensers and the mechanical draft engine, and from the exhaust heater the feed water is passed through a fuel economizer, which utilizes the waste gases from the boilers and heats the feed water up to 275 degrees before it enters the boilers. Any or all of this apparatus between the feed pumps and the boilers may be by-passed at will. The steam passes through large separators before going to the engines, and the water of condensation is returned to the boilers by a system of steam loops.

The steam piping throughout the plant is very heavily constructed to carry a working pressure of 175 pounds. The arrangement is very carefully designed to secure the greatest freedom from internal strains, due to expansion or contraction. It may be noted that the steam pipes from the boilers to engines are curved, avoiding elbows, and there are no pockets except those purposely provided for handling entrained water.

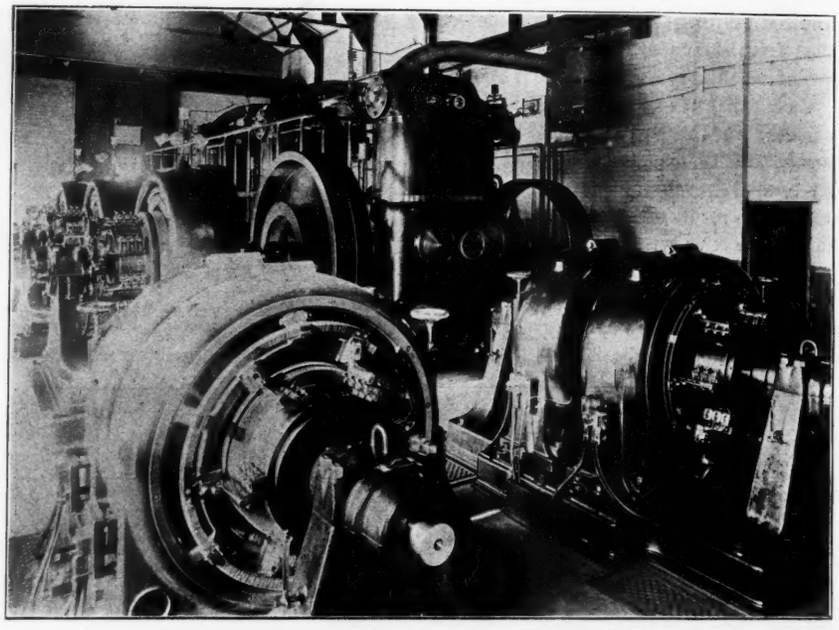


FIG. 3.—IN ONE OF THE POWER STATIONS OF THE DETROIT, YPSILANTI AND ANN ARBOR RAILWAY.

Three Worthington compound condensers 6 and 9 by 12 by 10 inches are installed in the basement of the power house under the engine room. The independent condensers are so connected that the engines can be used either condensing or non-condensing. A 10-inch intake pipe from the well by the river supplies water for the condensers, which is returned direct to the river. The condensers and engines are cross connected, so that in the event of one being disabled the other can be used to furnish a vacuum.

The engine room shown in Fig. 3 contains three 450 horse-power Westinghouse condensing compound engines, running at 250 revolution per minute, direct-coupled to electric generators. These engines are of the constant terminal compound type specially designed for the widely fluctuating loads incidental to railroad work. The usual load upon the engines is from 650 horse-power to 680 horse-power, but it is very fluctuating in character as the 9 to 12 cars operated upon the tracks meet at certain times in the turnouts, which causes the load, as registered by the ammeter, to vary from 100 amperes to 1,300 amperes, equivalent to a variation of from 70 horse-power to 900 horse-power. Two of the engines provide for the usual load, the third being held as a reserve. The mechanical draft is a valuable factor in controlling the supply of steam and the rate of combustion under the variably load. Two of the boilers, each rated at 225 horse-power, nominal capacity, with 150 pounds working pressure, are operated, the third being held as a reserve. It will thus be seen that the economy in consumption of steam is excellent.

The electrical equipment consists of three 225-kilowatt direct-current generators of 575 volts, connected to the engines by flexible couplings. There has also been installed in the power house one 135-kilowatt and one 125-kilowatt motor driven boosters. The motor and booster armatures are mounted upon the same shaft. The fields of both machines are supported upon the same bedplate and the split in a vertical plane to permit the removal of either half horizontally from its armature. The motor received power directly from the station bus-bars and the booster is operated in series with the feeders. The full-load voltage of the boosters is 325, making the voltage on the booster feeders at the station 900 volts. Views of one of the two boosters in the Ypsilanti station are shown in Fig. 4. One of the boosters supplies the line running westward to Ann Arbor, the feeder being tapped in at the Ann Arbor city limits, about seven and one-half miles from the power house. The feeder from the other booster, going east, taps in at Sheldon Corners an equal distance from the power house. The three feeder wires running east and west from Ypsilanti power house, and the one running west from the Dearborn power house, consist of 39,600 feet of copper

wire each. The Ann Arbor line measures 550,000 circular mils and the other two wires 400,000 circular mils.

The switchboard illustrated in Fig. 4 consists of 11 heavy marble panels mounted upon an iron framework of neat design, occupying one end of the generating room. The feed wires are carried from the bus-bars through the side wall to brackets on the outside and thence to the overhead construction upon the tracks. There are three generator panels, following the standard Westinghouse practice. Upon the fourth panel is a voltmeter and watt-

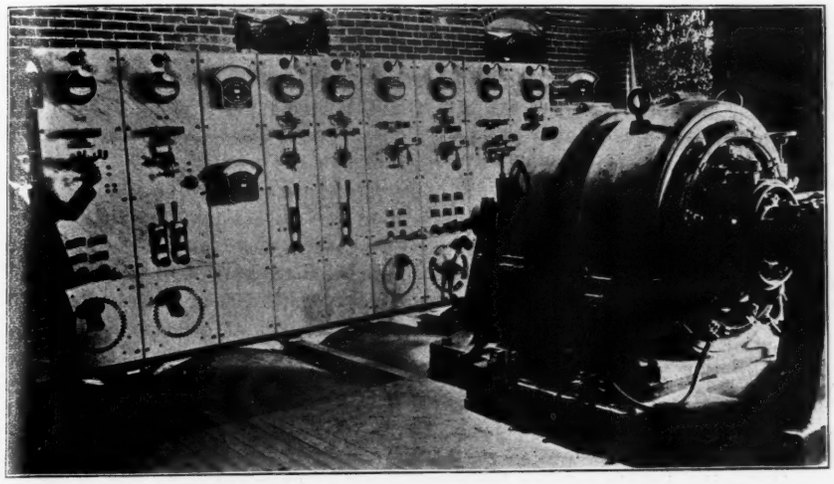


FIG. 4.—SWITCHBOARD AND BOOSTER, DETROIT, YPSILANTI AND ANN ARBOR RAILWAY.

meter showing the voltage and total current used upon the lines. Then follow the east and west feeder panels, and four panels for the motors and motor-driven boosters. The eleventh panel controls the south feeder for the Saline division. Voltmeters upon swinging brackets at either end of the switchboard show the voltage upon the line. The panels are supplied with the usual meters, circuit breakers, switches and other apparatus for the complete control of the current under all conditions.

The stations at Ypsilanti and Dearborn are arranged to work in parallel, helping each other out in case of a very heavy load upon either one, but they can be separated in case of need. Arrangements are designed so that either booster may be operated in series with either booster feeder. The switches are so arranged that the booster feeders may be used for supplementing the direct-fed feeders, should it become desirable to shut down the boosters.

The power house is equipped with an overhead seven and one-half-ton traveling crane, for moving any part of the machinery.

From the city limits of Detroit to Ann Arbor a single track has been laid by the side of the high road, of standard gauge, with frequent turnouts. Profiles of the country show a mainly level surface, with a few grades up to seven and one-half per cent in approaching bridges and where sudden dips occur. The track has been laid in the most substantial manner, with cedar ties upon a gravel bed, according to the best steam railroad practice. Upon the curves, which are few, the outer rail is elevated and the strong, substantial roadbed enables a speed of 45 miles an hour to be readily maintained by the cars. The standard used is a T-rail of 77 pounds section, but parts of the track are laid with 70 pounds and 75 pounds. The rails are bonded with 0000 joint bonds, with 0000 cross bonds every 500 feet.

The overhead construction consists of two 000 "Figure 8" trolley wires, the two wires being used to avoid switches at the turnouts. The eastbound cars are run on one trolley wire and the westbound cars on the other. The two wires are in parallel, being tied together every 500 feet. Upon the Saline division a 000 "Figure 8" trolley wire is used with a 0000 feeder wire in parallel. There are 25 miles of span construction work, the trolley wires being suspended from the poles on either side, and about 18 miles of bracket construction.

The standard car used by the Detroit, Ypsilanti & Ann Arbor Railway shown in Fig. 5 is 50 feet in length, the motorman's cab at one end, the cars having a seating capacity for 56 passengers. The present equipment consists of 20 cars, built by the Barney & Smith Car Company, of Dayton, Ohio. They are of extra width, the interior being handsomely finished, and the cross-seats upholstered with plush. Each car is warmed by Baker hot water heaters in Winter, and an ample supply of electric lights are provided. The cars are equipped with Westinghouse quick-acting air brakes of special design, which have given the highest satisfaction, as the motorman has complete control over these heavy cars, which weigh 26 tons when loaded, the air brakes enabling a stop to be made with the greatest rapidity. An air compressor, driven by a direct-connected motor is mounted in the cab of each car. The motor is automatically controlled by a pneumatic switch so that it starts as soon as the air pressure in the reservoir falls below 70 pounds, and stops when the pressure is raised to 100 pounds. This automatic system of air brake apparatus is highly efficient and is claimed to be the most reliable in operation.

Each car is equipped with double trucks, upon which are mounted four 50-horse-power railway motors of the well-known multipolar type, with ironclad armatures. Each car is also provided with a series-multiple controller, for operating the motors in combination of pairs in series multiple and all motors in multiple; the canopy switch is in the form of an automatic circuit breaker, thus enhancing the ease of operation, when using the heavy currents required. The cars also carry hand brakes.

The railway company constructs its own

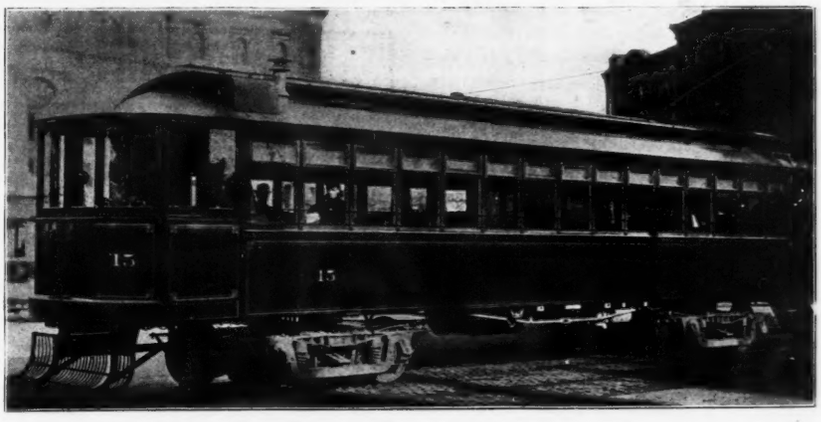


FIG. 5.—STANDARD 50-FOOT PASSENGER CAR, DETROIT, YPSILANTI AND ANN ARBOR RAILWAY.

fenders for the cars, of the projecting cradle type. A well-equipped repair shop is in operation at the car barns at Ypsilanti, furnished with the necessary machinery for repairing breakdowns of the cars, for rewinding armatures, machining car wheels and axles and for general repairs of electrical machinery. Power is furnished for the repair shop by a 10-horse-power multipolar direct-current motor. A regular half-hour service is provided between Detroit and Ann Arbor. Cars are run over the line at regular intervals, special cars for excursion parties being dispatched between the times of regular service. Occasionally the traffic necessitates a 15-minute service. An operator at the Ypsilanti office dispatches

all cars by telephone, the conductors reporting their arrival and departure from each point; a complete control is thus maintained. A single car provides for Ann Arbor, the fare being $1.12.

The cash fare from Detroit to Ann Arbor, a distance of 40 miles, is 60 cents if paid upon the car, or 50 cents if a ticket is bought at the office before starting. Mileage books are sold for 1,000 miles at the rate of one cent a mile. The schedule time for the journey of 40 miles is two and one-quarter hours. The ordinary train on the steam railroad occupies one hour and forty-three minutes between Detroit and Ann Arbor, the fare being $1.12.

A very interesting calculation was made regarding the amount of local traffic upon the railroad between Ann Arbor and Detroit, which is paralleled by the electric traction lines, it being found that immediately prior to the opening of the electric railway the local traffic averaged 200 passengers a day. The figures of the Detroit, Ypsilanti & Ann Arbor Railway show that during the past year they have averaged 4,000 passengers a day and during the month of September the average fare per passenger was fifteen and nine-tenths cents. It is thus clearly shown that when the public are given facilities for travel at an economical rate, a valuable traffic can be developed. It must be borne in mind that the railway system under review has but just completed its first financial year. These excellent returns have enabled the company to earn a dividend for the stockholders.

Fourteen cars have run 120,000 miles during one month. For such a service only the best materials, the strongest cars, the latest mechanical and electrical machinery and apparatus could make such a continual strain possible. The wisdom and foresight of the promoters of the line in securing the most perfect equipment is fully demonstrated.

The advent of the electric road has been of untold value to the country through which it passes. Building operations have had a marked stimulus along the route. In Wayne, hitherto a small village, 50 houses have sprung up, and a similar impetus has been given to other places. A considerable tract of land is now devoted to market gardening, since the way is opened for frequent and rapid markets. Various industries have been initiated, and a new life poured into the veins of the inhabitants, stimulating a healthy activity on all sides.

The railroad passes through a richly productive country, partly agricultural and partly horticultural, which yields a large freight traffic. At present only one freight car makes two round trips a day from Detroit to Ann Arbor, but so great is the demand for increasing this freight service that the company is making arrangements for a central clearing house in Detroit, where an exchange can be made with all the interurban lines running into the city. It is proposed to secure a separate building in connection with which there will be a regular service of wagons for collection and delivery. At present the company is in the anomalous position of curbing the development of this branch of its business by charging very high prices, on account of the poor facilities it possesses for receiving and distributing in Detroit. In spite of charging two-thirds more than the steam railway company, it receives more freight than the car can take care of. Two rates of charge are in vogue, one for freight and the other for express matter. Express packages are carried in the baggage department of the passenger cars. The rapid and prompt delivery of packages by electric cars is in itself sufficient to attract a large business. As soon as arrangements are completed at the Detroit end, the company fully anticipates earning from $3,000 to $5,000 a month in place of the $1,000 a month now received for freight. The country served by the railway produces a large quantity of raspberries, strawberries and other fresh fruits as well as garden and dairy produce. Packages of merchandise can be picked up by the freight cars at all points along the line, and goods can be similarly delivered, affording the greatest facilities to shippers and receivers.

The great success attendant upon the operation of this electric railroad has led to the initiation of several projects of a similar nature. Messrs. Westinghouse, Church, Kerr & Company are constructing other lines of greater length. The experience gained in the operation of the Detroit, Ypsilanti & Ann Arbor Railway points to the certainty of developing remunerative traffic.

AUTOMOBILES

The capital stock of the Illinois Electric Vehicle Transportation Company has been reduced from $25,000,000 to $2,500,000, the shares to be $10 par value instead of $100. In announcing the reduction the directors state that the funds in the treasury are sufficient to meet all present and immediate future requirements. The call for an assessment of $5 a share on the stock due July 1 is withdrawn, but the directors are empowered to call in the unpaid balance up to $10 due upon each share.

United States Consul Worman reports from Munich, Germany, that the Bavarian Government has just set aside the city ordinance preventing the use of automobiles on the streets of Munich. This opens up one of the best German cities for American manufacturers of horseless vehicles of every sort, and wide-awake agents should be promptly sent to this field, so promising because of the large class of wealthy residents. Munich is the third largest city in the German Empire. The streets are well paved, bicycles are popular, and horses dear. The opening should not long be neglected by American enterprise.

At the Greater Inter-State Fair, which is to be held at Trenton, N. J., September 24 to 28, 1900, there will be automobile races and an automobile exposition, both under the direction of Mr. E. E. Schwarzkopf. There will be no charge for space allotted for exhibiting automobiles or their accessories. The allotment of space will be made on August 31. There is a charging station on the fair grounds for electromobiles. All information can be furnished by Mr. M. R. Margerum, secretary , Trenton, N. J., on or before July 15, 1900. The races are to be five in number; three of five miles each, open respectively to electric, gasoline and steam vehicles; the fourth an open automobile run of ten miles, and the fifth of ten miles, open only to members of the automobile clubs of America, Philadelphia and affiliated institutions. The prizes offered are valuable and the entry fees small.

President Robert McA. Lloyd, of the Electric Vehicle Company, said last week: "On Wednesday last our stockholders authorized an increase of stock to the extent of $3,000,000 of preferred and $3,000,000 worth of common, so that our capitalization is now $8,000,000 of common stock and $10,000,000 worth of preferred. We formerly owned a half interest in the Columbia Electric Vehicle Company, and have now issued $2,400,000 worth of preferred stock and $2,400,000 worth of common stock with which to purchase the property. Our business continues good. At this time last year we employed 400 men, whereas now we have 1,700. We have orders enough on hand to keep us busy throughout this year." The directors of the company met in New York city on June 27, but took no action on dividends. Two new directors have been elected, Colonel Albert A. Pope and Mr. Herbert Lloyd. Mr. Lloyd is the vice-president and general manager of the Electric Storage Battery Company.

The kind of livery best suited to the New York automobile is still undecided, according to the New York *Sun*. Automobile fashions came first from the French. English use of the automobile followed and the English makers set out to invent a fashion of their own. They did this with such complete success that the two styles are quite different. The English liveries are noticeable chiefly for the elaborate frogging added by the London tailors. Both styles of liveries are used indifferently in this country with the advantage in numbers rather on the side of the French. Later purchasers of automobiles have on the other hand shown a preference for the English styles, so the question is now complicated to a degree unpleasant to owners of automobiles, of which every detail from the color of the vehicle to the driver's hat is a matter of importance. This confusion is not likely to last much longer, however. An effort is now being made by a number of automobile owners to come to some agreement as to the correct styles.

The Summer Convention of the Northwestern Electrical Association.

An Enjoyable Meeting of Northwestern Electrical Men at Waupaca, Wis.

The 1900 Summer meeting of the Northwestern Electrical Association was held at "Chain o' Lakes," Waupaca, Wis., on Tuesday, Wednesday and Thursday, June 26, 27 and 28, 1900. This is one of the most charming spots in the beautiful lake region of Wisconsin, and possesses admirable facilities for excursions and pleasure parties of various sorts. Good use was made of these by the members of the association, who always contrive to have a good time on their Summer outings. A large number of ladies were present and added greatly to the pleasure of the festive side of the meeting. A programme of excellent character was carried out, as will be seen from the detailed account of the convention which follows below:

TUESDAY, JUNE 26.

The convention was called to order in the meeting room in the Grand View Hotel by the president, Mr. Pliny Norcross, of Janesville, Wis. Mr. Norcross said in part:

It was at our last annual convention that the voice of our Lord persuaded us to build our Summer tabernacle on the banks of the clear lakes and flowing streams near Waupaca. The eloquence of that persuasive voice still rings in our ears. We have eagerly looked forward to the day when we should be made to lie down in the green pastures and be led beside the still waters of that fair Beulah land so vividly described upon that occasion. The Lord's promise and our firm faith in its fulfillment have made the intervening days seem shorter and brighter. We are here.

Nothing that was told to us compares with the beautiful reality. The lakes are clearer and more numerous than we imagined, the air is laden with the spicy perfume of wild flowers, the charming seclusion of "deep-tangled wild-wood" which we find on the lake banks, exceeds the picture which was presented to our admiring gaze at the Pfister Hotel.

We have wandered over the hills and through the dales and have been fascinated by the varied scenery; we have breathed the pure atmosphere, have quenched our thirst from the clear water of these gem-like lakes, until we are renewed by the zeal, vigor and spirit of eternal youth.

We are glad to be here. We are thankful for the opportunity to shake hands with the enterprising men who have discovered to us this charming spot of Nature's grand domain. Wisconsin is justly famous for its beautiful summer resorts, but among all its beautiful places there is none fairer or better than the chain of lakes about Waupaca.

After the president's address, Mr. Gebhard M. Dahl, the city attorney of Waupaca, delivered an address of welcome. He said, in a few well-chosen remarks, that he had never seen such a jolly lot of men in all his life, that he had never seen so many fat men gathered together before, and that he turned over the city of Waupaca to the visitors to do with as they pleased so long as they had a good time in it. The address was received with much applause. The journal of the proceedings of the eighth annual convention of the association, at Milwaukee, January 17 to 19, 1900, was adopted as the minutes of that convention. The badge committee reported that it had selected a badge in the shape of a button made in coin silver. It was decided that these be sold to members at 75 cents each. After a small amount of routine business the convention adjourned to 2 P. M. At the afternoon session the following applications for membership were presented, and the gentlemen and companies mentioned were unanimously elected:

Bryant Electric Company, Chicago; Manhattan General Construction Company, Newark, N. J.; H. B. Kirkland, American Circular Loom Company, Chelsea, Mass.; Belden-Larwill Electric and Manufacturing Company, Fort Wayne, Ind.; Frank S. Smith, manager Sawyer-Man Electric Company, Allegheny, Pa.; Dearborn Electric Company, Chicago, Charles Messer, treasurer; Charles R. Bishop, secretary and manager, American District Steam Company, Lockport, N. Y.; L. C. Van Ness, Madison, Wis.; Edward W. Anger, Jr., Chicago; Richard R. Bryan, Atlanta, Ga.; John P. Dales, Chicago; R. C. P. Holmes, purchasing agent, Chicago Edison Company, Chicago; People's Gas and Electric Company, Peoria Ill.

Mr. W. Worth Bean, of St. Joseph, Mich., then read a paper on "Advantages of Recording Wattmeters on Switchboards."

Mr. Bean said that recording wattmeters had been used on the switchboards of his company for three years past; he had found that the meter was valuable as a means of comparison of different kinds of coal, inasmuch as the daily output of the station and the amount of a certain kind or quality of coal burned could be compared intelligently. It has also an excellent moral effect on the firemen who know that the totalizing meter is keeping tally of their firing and will not permit them to talk about inferior coal or heavy loads as excuses. As an indication of waste on the lines in leaks, transformers, etc., the instrument is invaluable, as its records may be compared with the total of consumers' meters. He considered that such a meter is really an indispensable instrument in a modern station, and that its cost is a mere bagatelle as compared to the saving in coal which an intelligent study of its indications will effect.

Replying to a question by Mr. W. B. Baker, Mr. Bean said that in a flat-rate station, of course, the loss on the line can not be detected by means of a station meter. Mr. Bean described his station at some length. It is a complicated, old-fashioned station, containing railway and lighting machines of many varieties, and he showed how he used totalizing meters for each kind of current that it supplied.

Mr. F. A. Copeland told of the plant at La Crosse. In it the output is registered at the station and also on the consumers' meters. The difference runs from 20 to 35 per cent, and averages about 27 per cent, which he believed to be a fair showing. This is a direct-current, three-wire system station.

Mr. L. A. Ferguson, of Chicago, gave the experience of the large Edison stations there. In them it was found that the difference between the totals of consumers' meters and the registrations of those on the switchboards is 18 to 20 per cent. Part of this, of course, is due to the line loss, but the balance is unaccounted for. With alternating-current stations it has been known to be as high as 50 per cent.

Mr. T. F. Grover asked him about the output of stations in watts per pound of coal. Mr. Ferguson said that for four or five years he had been keeping a record of the cost of fuel per kilowatt-hour. "We made an interesting contract two years ago," he said, "for a supply of coal for one year, and in that contract we were guaranteed that the cost per kilowatt-hour of our fuel should not exceed a certain amount. Now if we could buy our coal on that basis all the time we would be in splendid position. Unfortunately for us, one year was sufficient for the coal operator and we have never been able to make a contract like that since." (Laughter).

Mr. Grover said that he would like to have a comparison of the cost per kilowatt-hour from small stations. In reply to a question by Mr. Copeland, he said the average price of coal at his station was about eight mills per pound.

Mr. Frank McMaster inquired about the variety of engines used. Mr. Copeland said that coal costs him about one cent, but that when his engines are all condens-

ing compounds, which they soon will be, he expected to reduce this cost to about eight mills.

Mr. William H. Edgar then delivered an address on the subject of "Wet Steam." This was as follows:

I am here at the request of your worthy secretary and I really did not know what to take as a subject, when, in an off-hand manner I gave him the title "Wet Steam." Now, wet steam, of course, you are more familiar with than I am. It is produced from two different causes in the boiler, one is priming and the other foaming. Priming I have nothing to do with; that comes under mechanical defects and belongs to the engineering profession. Priming is due, as you well know, to the lack of delivery surface or lack of steam space and to the mechanical construction of the steam dome, and especially the connections between the different domes in water tube boilers. But wherever such a mechanical defect might exist, the water, you might say, would spatter the steam if your boiler water contained salts of soda.

Foaming is caused by saponification. I do not believe that foaming in a boiler is caused by mud or dirty water. I think it is due to the soda contained in the water and, as a rule, wherever you have a river; that is to say, using river water containing mud, you have more or less soda in the form, not only of a carbonate, but of a sulphate. You are probably well acquainted with well waters and the tendency that they have to foam after running a week or two; and the reason that I took as a subject "Wet Steam" was due to the fact that I believe that in ninety cases out of a hundred the moisture in your steam is due to saponification or due to the presence of soda. You might have a great excess of lime and magnesia in solution in your feed water, but when the water is introduced into the boiler and brought in contact with that degree of heat, your lime and magnesia is thrown out of solution into suspension, and consequently you get no action whatever in the way of foaming. It does not increase the density of the water, it is not part of the water, it is not in solution. Soda always remains in solution. Ninety per cent of the waters throughout the country used in boilers contain considerable lime and also some soda, and nine plants out of ten are treated in one way or another with some one or the other salt of soda, and you get the same action in all such cases that you receive from the use of artesian well water and surface well water in certain places where the soil contains sulphate of soda and generally the carbonates.

Now what I wanted to refer to was the fact that you all know that it is essential to get as dry steam as possible, and if you could get absolutely dry steam, you could use a straight mineral cylinder oil without requiring the admixture of any animal oil whatever. The animal oil is necessary only to take care of the water. The condensation washes off the mineral oil, necessitating the compounding with an animal oil to hold it, to give it the clinging, adhesive, film-cutting properties of a good cylinder oil.

On a certain railroad they condemned the oil and sent it back repeatedly month after month, during the last couple of years—in fact, the last year—and could not buy anywhere else except of one company, and they had considerable difficulty in getting an oil to meet their requirements. They finally got up to about 35 per cent of tallow in the compounding. They were using soda ash in the boilers, and the more soda ash they used, the more moisture they had in their steam, the more they saponified the water, the more moisture was carried over, and with this moisture came soda and the more soda that came over, the more it cut the animal oil, saponifying it, forming soap, and they had considerable difficulty before they found out really where the trouble lay.

I believe that throughout the country, in different plants, a great many good cylinder oils have been repeatedly condemned, all due to the well water used, carrying the water a little too high in the boiler, or using some preparation of soda; and, of course, the higher you carry the water, and the more you agitate the water from a sudden opening, I suppose, of the valve in the delivery of steam, the more readily it foams, and I believe that in all your practice in the engine room, if you would watch your water level and the nature of your water, so as to know the amount of soda it might contain, it would enable you better to take care of the oil question.

Caustic soda, in a saturated solution, would contain 59 per cent of caustic soda; a saturated solution of soda ash would contain 40 per cent soda ash, when it would begin to cake; with salt you would have a 35½ per cent saturated solution before it would cake. All sodium salts remain in solution until the solution is saturated, and then they cake and always cake at the hottest part of the boilers. It is quite common in Kansas and in New Orleans and in the Hawaiian Islands and along the seacoast, where they use salty water, to buckle the tubes and bag the sheets on account of salt.

So I brought this question up and state that I believe that nine-tenths of the wet steam and cases of foaming are due to soda.

Mr. McMaster asked what was the best test for excess of soda. Mr. Edgar said an analysis of the feed water was the only course. In a plant at San Francisco, where salt water was a difficulty, he had known of testing the feed water by tasting it. Replying to a question by Mr. Copeland, he said scale would give no indication of the amount of soda. A good deal depends also upon the type of boiler and how well made it is. Replying to Mr. W. S. Schott, he said that it was a general fault of firemen to carry water too high in boilers. A lime water will not foam, Mr. Edgar said.

At the close of the discussion a vote of thanks was unanimously tendered to Messrs. Bean and Edgar for their interesting addresses. The meeting then adjourned until the next day.

WEDNESDAY, JUNE 27.

The convention was called to order at 11 A. M., and Mr. W. W. Bean was asked to act as secretary on account of the unavoidable absence of the regular secretary. Mr. H. H. Wait being absent, his paper on "Street Lighting" was not read. Mr. Louis A. Ferguson, of Chicago, read a paper entitled "Storage Batteries for Small Stations."

Mr. Ferguson said that the cost of a storage battery is dependent upon its kilowatt-hour capacity, whereas that of steam and electrical operating equipment is dependent upon its maximum kilowatt output. This being the case it is necessary to consider carefully the load curve of the station, and if the average width of its peak is more than one and one-half hours then the initial cost of steam and electrical equipment to provide for it will be less than that of the necessary storage battery at the present market price. If the curve has an average peak width of less than one and one-half hours, then the initial cost of the battery equipment would be less than that of engines and dynamos to do the same work. As an example, he spoke of the cost of storage batteries, taking as a typical case one of a capacity of 500 amperes at the one-hour discharge rate, would be as follows: One hour, $80 per kilowatt; two hours, $116 per kilowatt; three hours, $160 per kiowatt; eight hours, $320 per kilowatt.

These figures include everything except the building. The question of first cost, however, is not the only thing to be considered. Depreciation and reliability should be taken into account also. Mr. Ferguson considered the yearly efficiency of a storage battery under ordinary central station conditions as probably no greater than 65 per cent. A large number of interesting diagrams were exhibited by Mr. Ferguson, showing the various points brought out in his paper. He spoke at some length of the use of storage batteries for taking care of the minimum load when this is of long duration. When this is compared with the maximum load, for example, there are many places where the lighting load is inappreciable except during the hours from 6 o'clock P. M. until midnight. He spoke also of double-current generators, giving out both direct and alternating currents, and of his conviction that such machines would find an extended use in small stations. With them the storage battery may be most economically combined. In summing the matter all up, it is impossible to lay down a set of rules determining the usefulness of the storage battery. It is likely, however, that there is no economical advantage, though there may be a sentimental advantage in the use of a storage battery in a lighting system where the average width of the peak is more than one and one-half to two hours.

In reply to a question by the president, Mr. Ferguson said that very few small stations can use storage batteries. Mr. Copeland said that he thought it was cheaper in a case he cited to put in an additional generator. Mr. Ferguson said that there was absolutely no place from an economical standpoint for a storage battery in a small station with a long load peak.

Professor Swenson inquired as to depreciation of a moderate-sized battery plant under ordinary conditions. Replying, Mr. Ferguson said if a guarantee could be obtained from the storage battery company it would be about 90 per cent. On large

installations, where the batteries are carefully attended, depreciation figures out as low sometimes as five per cent, but more frequently at six per cent.

Professor B. F. Swenson then read a paper by Professor A. W. Richter and himself entitled "Practical Testing of Small Lighting Plants." This paper will appear in a later number of the ELECTRICAL REVIEW.

A unanimous vote of thanks was extended to Professors Swenson and Richter for their valuable paper.

Mr. F. E. Hatch then addressed the convention on the subject of his electric smelting apparatus. He gave a large number of figures and a description of the type of revolving electric furnace made by his company. Replying to a question by Mr. Bean, he said that these furnaces were worked at 10 volts, alternating current. Mr. Debell thought that the furnace would be of considerable use in smelting ores but it would not be valuable to an electric light station except one situated in the neighborhood of such a smelting industry. The convention then adjourned until 11 o'clock the next morning.

At 4.30 in the afternoon the convention indulged in "Olympian Games," under the direction of Mr. George S. Whyte. At 7.30 o'clock in the convention hall the "Northwestern Minstrels," an aggregation of stupendous talent, composed of members of the association, broke loose for an hour or more and did "stunts" of various kinds, inflicted old, hoary chestnuts on the audience, and set everybody to laughing; they were a great success. This was followed by a Summernight ball in which everybody present who knew how to dance took part in the enjoyment, while the others stood around and looked on.

THURSDAY, JUNE 28.

The convention was called to order promptly at 11.30 A. M., and Mr. Guy V. Williams, of Minneapolis, and the Illinois Maintenance Company, Chicago, were elected members of the association.

Professor G. D. Shepardson, who was absent, sent in his paper on the subject of "Why Some Municipal Plants Do Not Pay." Upon motion it was unanimously decided to print the paper in the transactions of the association.

A paper on street lighting by Mr. H. H. Wait was also presented and will be printed in the transactions of the association.

Upon motion of Mr. Copeland, who said that he was certain that the secretary and treasurer's office would run short of money, and that the amount of work done this year by that office had been very large, a sum of $200 was appropriated for the use of the secretary-treasurer for the year 1900. Mr. Thomas C. Mercein, the secretary, thanked the association for their action and said that his work had been heretofore purely a labor of love and interest. Upon motion of the secretary it was determined to spread upon the record of the association a vote of thanks to Mr. I. P. Lord and Mr. W. B. Baker for their courtesy to the convention and also to Mr. James Wolff, Mr. W. W. Low and Mr. George S. Whyte for their individual efforts to make the convention a success, and finally to the ladies of Waupaca for the many courtesies they had extended to the association. An adjournment was then taken until January, 1901.

At 1.30 in the afternoon a steamer trip was taken through the beautiful "Chain o' Lakes," and at 4.30 aquatic sports such as tub races, swimming matches, boat races, etc., were indulged in. The convention was one of the most successful and interesting in the history of the Northwestern Association and was greatly enjoyed by all who had the privilege of attending it.

NORTHWESTERN CONVENTION NOTES.

Gordon E. Varney, of Indianapolis, attended the convention with Mrs. Varney.

The United States Carbon Company, of Cleveland, was represented by G. R. Newcomer.

Mr. Al Smith, of Keelyn & Smith, Milwaukee, Wis., was at the convention with Mrs. Smith.

The Gregory Electric Company, of Chicago, was represented by Mr. H. O. Kuhmsted and Mr. R. H. Watson.

Mr. Robert L. McOuat, of Indianapolis, was there with Mrs. McOuat and entertained a number of friends.

Mr. J. G. Pomeroy, representing the Adams-Bagnall Company, Chicago office, was there with Mrs. Pomeroy.

The Illinois Insulated Wire Company had Mr. Fred H. Alden to look after its interests. Mrs. Alden accompanied him.

Mr. Thos. J. Mercein, secretary of the association, deserves great praise for the excellent time all enjoyed while at Waupaca.

The Shelby Electric Company, of Shelby, Ohio, had two gentlemen at the convention, Mr. O. D. Pierce and Mr. W. M. West.

The Electrical Supply Company, of Madison, Wis., had Mr. L. W. Burch in attendance. He was accompanied by Mr. Burch, Jr.

The General Electric Company had the following gentlemen at the convention: Mr. J. Scribner, W. H. Coleman and Tom Ferris.

The Dearborn Drug and Chemical Works was represented by Mr. W. H. Edgar, its president, who is always prominent at conventions.

The Wagner Electric Manufacturing Company, of St. Louis, Mo., had Mr. Geo. B. Foster, of the company's Chicago office, at the convention.

The Illinois Electric Company, of Chicago, was represented by Secretary Lem C. Cushing, who faithfully attended all the meetings, also by Mr. C. W. Bacon.

The Peru Electric Manufacturing Company, of Peru, Ind., was represented by Geo. S. Searing, who also looked after the interests of Messrs. Hart & Hegeman.

The New York Insulated Wire Company was present in the person of Mr. James H. Wolff, who is well known as the company's popular Western manager.

The Leschen-Macomber-Whyte Company, of Chicago, was well remembered because of the presence of Mr. Whyte, who is always a great factor at these conventions.

The Fort Wayne Electric Works, of Fort Wayne, Ind., was represented by Mr. F. McMasters. An interesting display of this company's manufacture was exhibited in the convention hall.

The Buckeye Electric Company and Jandus Electric Company, two companies well-known in electric lighting circles, were represented by Mr. Joseph H. Cook, of the Monadnock Block, Chicago.

The New York & Ohio Company, of Warren, Ohio, made Packard lamps and transformers known among the visitors through Mr. W. D. Packard, who was accompanied by Miss Carlotta Packard.

The Electric Appliance Company, of Chicago, was represented by its president, Mr. W. W. Low. Mr. Low's popularity among the delegates was second to no one else, as has been the case many times before.

The Westinghouse Electric and Manufacturing Company was represented by Mr. W. R. Pinckard. Mrs. Pinckard also attended the convention and greatly enjoyed the pleasant entertainments provided.

The General Incandescent Arc Light Company had three representatives present: Messrs. Francis Raymond, Western sales manager; M. B. Kitt, Minneapolis manager, and Thomas James, Milwaukee manager.

The Manhattan General Construction Company, of Newark, N. J., was represented by Mr. Frederick L. Merrill, who furnished a number of red, white and blue hats as his contribution to the gaiety of the occasion.

The Badt-Goltz Company, of Chicago, had an exhibit in the convention hall showing Weston instruments, Ward Leonard circuit breakers and Helios-Upton arc lamps. Mr. Wm. Goltz, accompanied by Mrs. Goltz, was at the convention.

The American Steel and Wire Company had present Mr. Channing T. Gage, sales agent of its St. Paul office, who takes in all the conventions. He distributed wire fish hooks, saying, "Give us a nibble and we will do our best to land your order."

The American Circular Loom Company, of Chelsea, Mass., arrived early. It was represented by Messrs. H. B. Kirkland, of New York city, and Thos. G. Grier, of Chicago. They distributed doll-babies to the ladies and silver-plated spoons to the gentlemen. The dolls were in great demand and created much amusement and the spoons were worn on the lapels of the gentlemen's coats. Lemons were hard to get, but "Kirk," of the American Circular Loom Company, ordered all he could get in Waupaca and provided a refreshing drink for the thirsty crowd.

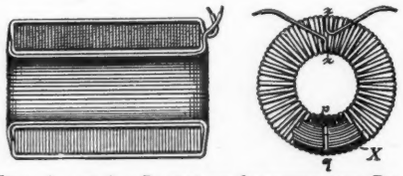
Dr. Pupin's Distortionless Circuit Patents.

Two patents have just been issued to Dr. M. I. Pupin for the "Art of Reducing Attenuation of Electrical Waves and Apparatus Therefor," which cover the method described in the paper, by the patentee, read before the recent meeting of the American Institute of Electrical Engineers, and reprinted in the ELECTRICAL REVIEW for May 23 and 30, 1900. The patents are very interesting on many accounts and their specifications contain data of great importance. The following description of the calculation of a long submarine cable for telephonic purposes is taken from them:

Suppose it be required to transmit speech telephonically over a submarine cable 2,000 miles long. In this case inductance coils of small volume are preferable on account of considerations of mechanical construction. To secure high-inductance with small volume, steel or iron cores should be used to avoid excessive ohmic resistance. Coils having iron cores are a source of three kinds of losses; *viz.*, those due to Foucault currents, hysteresis and ohmic resistance. Each one of these losses has to be very small if the coil is to be efficient. I have found that this can be accomplished at any rate when it is required to transmit only small quantities of energy. If the core is finely subdivided, Foucault currents are negligible, especially for exceptionally weak magnetizations, such as will be employed in the case before us. It will now be shown that hysteresis also can be made negligibly small. Let the wire have a resistance of five ohms per mile. According to present cable construction the capacity per mile with wires of such size is very nearly three-tenths microfarad. Introduce inductance coils at proper distances, so as to make the inductance three-tenths henry per mile, and suppose that these coils add one ohm per mile, thus increasing the ohmic resistance to six ohms per mile. The wave length for a frequency of 1,500 periods per second will be two miles, approximately.

To secure a close approximation to the rule, it will be necessary to introduce sixteen coils per wave length or eight coils per mile. The inductance of each coil will then be .0375 henry. The resistance of each coil will be .0125 ohm. Employing cores of iron, or well-annealed steel, coils of this inductance can be readily made which will be small enough to go within the sheathing of a submarine cable as these are constructed to-day and at the same time show negligibly small Foucault current and hysteresis losses.

In Fig. 1 X′ is a ring-shaped disk. Its internal diameter is 2.5 centimetres and its external diameter is 6.5 centimetres. Its thickness is .002 centimetre, or about .005 inch. It has a narrow slit p. q. A core is built up by piling together a sufficient number of such disks to give the required length, which we will assume is 10 centimetres. In Fig. 1 a transverse section of such core is represented. Wind this core with two layers of wire having 8.5 ohms resistance per mile. Let each layer have 48 turns. The length of the wire will be 80 feet, and its ohmic resistance will therefore be little more than .125 ohm. Eight coils per mile will therefore, add one ohm per mile to the resistance, making the total resistance six ohms per mile. To calculate the inductance, the permeability of the iron must be known. In telephony the maximum value of the current at the sending sta-



FIGS. 1 AND 2.—DIAGRAMS ILLUSTRATING DR. PUPIN'S DISTORTIONLESS CIRCUIT PATENTS.

tion is generally less than .0001 ampere, or .00001 unit of current in the centimetre-gramme second system. The magneto-motive force of the magnetic circuit is for this value of the magnetizing current:

$$M = 4\pi s C = 4\pi \times 96 \times 10^{-5}.$$

The intensity H of the magnetizing force will be

$$\frac{M}{l} = H,$$

where l is the mean length of the magnetic circuit equal to 10 centimetres—roughly. Hence

$$H = \frac{4\pi \times 96}{10^6} = .0012.$$

For excessively feeble magnetizing forces of this kind the magnetic permeability of first-class iron is about 180. The intensity of magnetic induction will be $B = 180 \times .0012 = 22$ lines of induction per square centimetre. At this excessively low induction there is no hysteresis. The inductance of the coil can now be easily calculated. The formula is

$$L = \frac{4\pi s^2 q \mu}{l \times 10^9},$$

where

s = number of turns = 96.
q = cross-section of core in sq. cm. = 20,
μ = permeability × 180.

Hence

$$L = .042 \text{ henry}.$$

The diameter of the coil, when finished, will be less than 2.5 inches and its length 4.25 inches. Such a coil can be placed conveniently within the sheathing of a submarine cable. Its diameter can very easily be reduced by increasing its length.

It should be observed here as a warning that unless inductance coils with iron cores are constructed in such a way as to keep down the magnetization, hysteresis, Foucault current losses and distortation of current by the varying value of the magnetic permeability at each cycle of magnetization will work disastrously. The limit of magnetization permissible will not, however, be passed even if the magnetizing current is 30 times as large as is assumed above—that is, the magnetizing current can be as high as three milliamperes—a strength of current which is capable of operating telegraphic apparatus. It should also be observed that the iron core represented in Figs. 1 and 2 can be made by winding very fine iron wire, the plane of the windings being perpendicular to the axis of the cylindrical tube which constitutes the core. The advantage of this core is that it still further reduces the Foucault current losses and also prevents magnetic creeping. The cross section of the wire core would have to be made larger than that of the plate core to allow for the more imperfect filling up of the available space by the substance of the wire.

Is the Sun's Corona an Electrical Phenomenon?

Mathias Cantor in the *Annalen der Physik* for March, 1900, describes an experiment showing that a rarefied gas through which an electric discharge is passing has no perceptible absorption spectrum corresponding to its emission spectrum, and Professor G. F. Fitz Gerald in *Nature*, May 3, 1900, remarks that this fact confirms the suggestion that the sun's corona is an aurora around the sun (an electrical discharge phenomenon) inasmuch as the bright spectrum line of the corona is not represented by a dark line in the solar spectrum. The absence of an absorption spectrum corresponding to the emission spectrum of a rarefied gas through which an electrical discharge is passing is very likely due to very great concentration of kinetic energy, among a few types of the molecular motion of the gas, so that in regard to its emission the gas is potentially at an excessively high temperature.

An Automatic Electric Car Lighting System.

One of the minor problems of electric lighting, but one that has proved of great difficulty, is that of illuminating railway cars and trains. The conditions of train service are such that each car must be independent of the others (since the train may be divided or separated into its individual cars) and this necessitates a storage provision on each car. Naturally, since primary batteries are out of the question, the most obvious direction to turn to is the use of the motion of the car itself as motive power to drive a dynamo, and a storage battery, both for purposes of regulation, and to provide current when the car is standing still or going at speed too slow to operate the generator properly.

Its operation will readily be understood from an inspection of the two illustrations herewith. Fig. 1 shows the arrangement of connections in dynamo, and Fig. 2 is a view of the generator in place under a car, having its dust-proof casing removed so as to show its machinery.

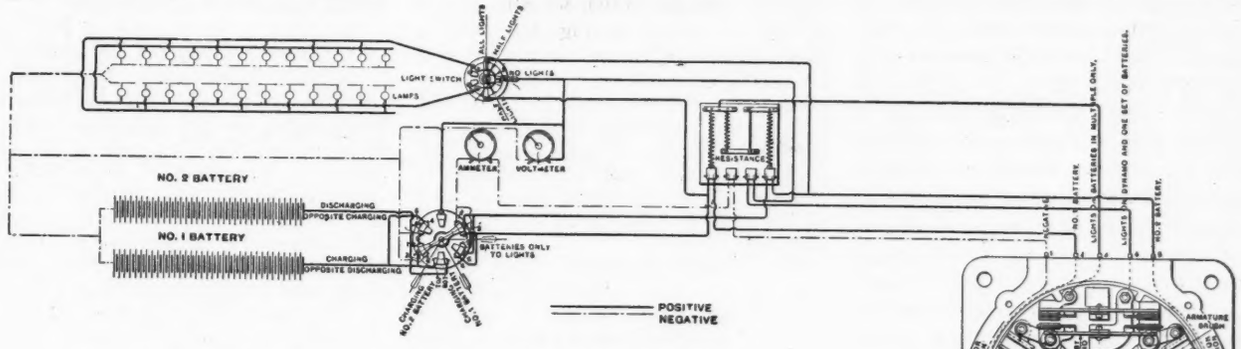
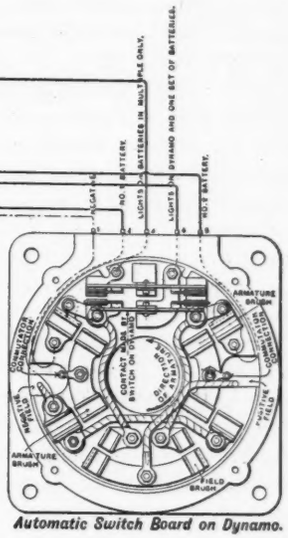


FIG. 1.—DIAGRAM OF AN AUTOMATIC ELECTRIC CAR LIGHTING SYSTEM.

Turning first to Fig. 2, the essential feature of the generating element is the ironclad, shunt-wound dynamo, suspended by a frame consisting of four links from an adjustable carriage running on guides so that it may be shifted in the direction of the belt. The belt, of the leather link variety, is driven from a pulley mounted at the centre of one of the axles of the car. The link and carriage motion not only varies the tension upon the belt, but permits the suspended machine to oscillate a little and thus take up the motions experienced by the axle in rounding curves, etc. At the end of the shaft of the dynamo is a ball governor of simple design, which is so arranged that when the speed of the dynamo has increased to a certain point, corresponding with a definite voltage, the governor will act and move the switches shown in Fig. 2, and also in diagram in Fig. 1, to such a position that the machine begins to feed the storage battery. Now, as the speed increases, regulation is accomplished by the extraordinarily simple method of allowing the belt to slip in part. It is said that the current forced into the battery will not pass a certain point, no matter how fast the car runs. When the limit, which can be adjusted in advance, is reached, the belt begins to slip, and the machine generates a current of only that strength for which the belt tension was adjusted. Should the car go backwards then a simple friction arrangement is carried over by the first fraction of a revolution and shifts the connections of the dynamo appropriately



Automatic Switch Board on Dynamo.

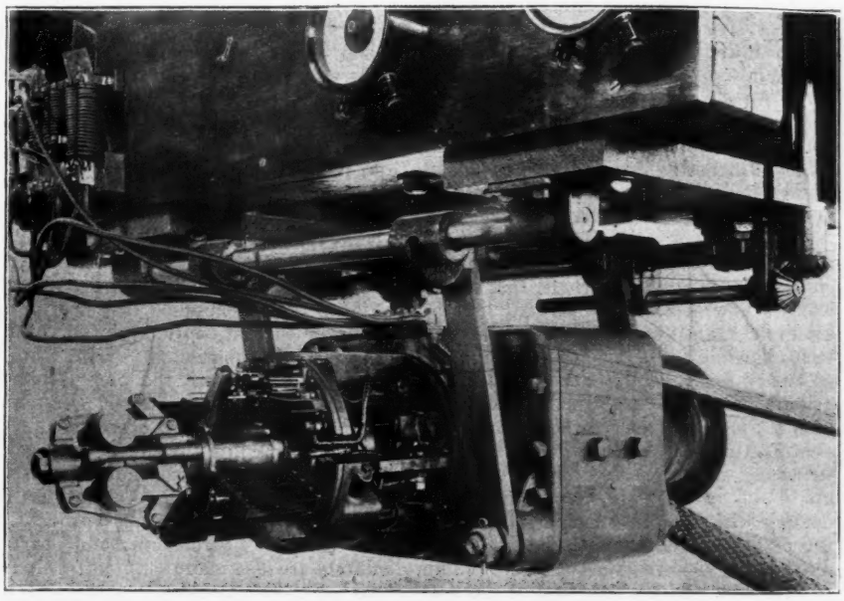


FIG. 2.—DYNAMO OF ELECTRIC CAR LIGHTING SYSTEM. SHOWING METHOD OF SUSPENSION, GOVERNOR AND COMMUTING DEVICES.

All of the lighting in the car is controlled by one switch which has three positions, representing respectively no light, half of the lamps lit, and all of the lamps lit. A feature of the system is a division of the storage battery into two parts. By appropriately shifting and commuting the two sets of battery, a resistance and the contacts in the dynamo casing by the governor on the dynamo, an exceedingly perfect regulation of voltage is maintained with great economy in the operation of the system. As usually installed, each battery consists of 13 cells and the two portions are worked in multiple or singly, 25-volt lamps being used. In the large number of cars that have already been equipped with this system it has been found, from various practical considerations, that this voltage is best adapted to the requirements of practical service. The system is being introduced by the Gould Coupler Company, New York city, which is now operating a number of cars on the Delaware, Lackawanna & Western and other railroads in the vicinity of New York, as well as a large number on the Canadian Pacific and other northern and western roads.

To this character of systems belongs the Gould car lighting system, which has recently been introduced in this country, after having been in use in a less perfect form for some years in the British Isles.

ADVANCEMENT OF ELECTRICAL CHEMISTRY.*

BY F. MOLLWO PERKIN.

In the year 1800, Nicholson and Carlisle showed that water could be decomposed into oxygen and hydrogen by means of a "volta pile;" since that time the electrolytic decomposition of water has been employed as a lecture experiment to show the composition of water. It is, however, only quite recently that oxygen and hydrogen have been produced on a manufacturing scale by the electrolysis of dilute solutions of caustic soda or sulphuric acid. The hydrogen so obtained is usually almost absolutely pure, but the oxygen is generally mixed with about three per cent of hydrogen, which, however, can be removed by passing it through red-hot tubes.

The powerful oxidizing action of ozone has through the advancement of electrical science been pressed into the service of the manufacturer. The methods employed for its production are all more or less based upon the well-known Siemen's tube. Generally speaking, air and not oxygen is ozonized, the air to be ozonized being freed from dust and from excess of moisture, the last of which causes formation of hydrogen peroxide. The temperature should be kept as low as possible, because at low temperature oxides of nitrogen are less liable to be formed and the quantity of atmospheric oxygen converted into ozone is increased; indeed, some manufacturers cool the air down to four degrees centigrade before subjecting it to the electric discharge. For convenience of use the ozone is generally compressed into iron cylinders under a pressure of from four to five atmospheres. It is used for refining and bleaching linseed and palm oils, and for the manufacture of oxidized oil for linoleum. Brewers are often troubled with fouling of the beer barrels. This seems to be due to the growth of fungus, which often penetrates the wood to a considerable depth, so that ordinary methods of cleansing fail to remove it. The oxidizing action of ozone has been successfully employed to remove this growth, the method being to alternately steam and ozonize the casks. It has also been utilized to remove fusel oil from alcohol, in the purifying of water, the refining of sugar in place of animal charcoal, and in a great variety of other manufacturing processes.

It is well known that synthetical diamonds have been obtained by means of the electric furnace; charcoal obtained from sugar is rammed into a wrought-iron cylinder, which is then closed with a plug. The cylinder so filled is placed in a bath of molten iron kept at a high temperature in an electric furnace, after which the crucible which contains the iron is rapidly cooled by immersion in melted lead. On dissolving the iron in acid minute diamonds are obtained. It was a question whether here we had a case of simple crystallization of the carbon from the molten metal on cooling, or whether the enormous pressure which was exerted upon the interior of the mass by the rapid cooling of the outside acting upon the carbon at a high temperature caused the formation of crystals of diamond. An exceedingly ingenious experiment which has been carried out by Majorana shows that at any rate the influence of high pressure and high temperature combined is sufficient to convert amorphous carbon into the crytalline variety. Majorana's experiment is as follows:

A cylindrical chamber, A (Fig. 1), is hermetically closed at the top by a solid block of iron, E, the bottom by a solid piston, S. The sides of the chamber are made of tempered steel, and to further strengthen it the chamber is surrounded by 15 iron rings, one centimetre thick, which are bolted together. The whole system is placed within a hexagonal frame, K, also made from iron plates. The piston, S, has a small solid iron cylinder about one centimetre in diameter attached to it, at the end of which is fastened a small piece of carbon, C, about two grammes in weight. Directly below the piston a thick block of iron, *p*, is fixed, into which a hole exactly the size of the small end of the cylinder has been drilled. In carrying out the experiment the carbon is heated by means of the two carbon poles, D, D', with a current of 25 amperes and 100 volts. When the carbon has become white hot, 70 grammes of gunpowder contained in the chamber, A, is exploded, the piston being driven down, carrying the heated carbon before it and compressing it with enormous force. On taking the system to pieces the carbon is found to have been partially converted into microscopic diamonds, which, when freed from unchanged amorphous carbon are found to possess all the characteristics of natural diamonds.

Reference has already been made to the importance of the manufacture of calcium carbide; another carbide, that of silicon, is now being manufactured in considerable quantities, and owing to its extreme hardness, is being employed in place of emery for polishing steel and making grindstones. This carbide, which goes under the name of "carborundum," is manufactured by means of the electric furnace. An American company at Niagara Falls employs furnaces capable of dealing with 10 tons of material, consisting of coke, sand, common salt and sawdust, which yield two tons of carborundum in 24 hours. In the first half of the year 1897 it is stated that in America alone 750,000 pounds of carborundum were manufactured. Since the introduction of electricity to chemistry the carbides of almost all the metals have been obtained, the majority being more of theoretical than of commercial interest.

From the days of Leblanc, the founder of the soda industry, perhaps no branch of inorganic chemistry has been more worked at, or has better shown the results of patient toil and inventive genius, than the alkali and bleaching industry. Only after many attempts and many failures has the seemingly simple task of electrolyzing sodium and potassium chloride yielded results which have enabled electricity to enter into competition with the former methods of manufacture.

According to the manner in which the electrolysis is conducted, a solution of potassium chloride may be converted into chlorine and caustic potash, potassium hypochlorite, or into potassium chlorate. If the electrolysis takes place at low temperatures, a solution of hypochlorite is obtained, which may without further treatment be used for bleaching purposes. The difference in price between this solution and a solution of bleaching powder is not very great, but the greater cleanliness and purer bleaching action of potassium (sodium) hypochlorite make it, when electric power can be easily obtained, at least a powerful competitor with bleaching powder. When the electrolysis is conducted at temperatures from 60 degrees and upwards, the bath being kept slightly alkaline by addition of potassium bicarbonate or lime, potassium chlorate is produced, which, owing to its slight solubility in water, crystallizes out, and by washing is readily freed from adhering chloride.

If caustic potash and chlorine are required, some arrangement must be made to prevent the liberated chlorine from again reacting with the caustic potash formed at the same time. Formerly, and still to a small extent, this was arranged by means of a diaphragm which separated the anode from the cathode. Owing however, to the difficulty of obtaining a *pervious impervious* diaphragm, *i.e.*, one which allows the current to pass, but is impervious to the solution, it is now more general to electrolyze without a diaphragm. The method employed is one which was originally employed by Castner and Kellner, the cathode being a layer of mercury at the bottom of the bath. On the current being passed, the potassium liberated at the cathode dissolves in it, forming an amalgam, which as it is formed is drawn off and run into pure water, the water being decomposed, assisted by an auxiliary current, with evolution of hydrogen and formation of caustic potash, which is obtained in the pure condition by evaporation. Carbonate of potash may be prepared by passing a stream of carbonic acid gas into the caustic liquors before evaporation. In commerce, naturally, it is more general to electrolyze the cheaper sodium chloride, at any rate, in this country. Strontium and barium chlorate are also manufactured by electrolysis of their chlorides.

It has been found possible to prepare painter's colors by electrolysis, *e.g.*, "white lead," is obtained in a very pure condition by electrolyzing a dilute solution of sodium chlorate and carbonate, the electrodes being of lead. If the sodium carbonate is replaced by sodium chromate, a neutral lead chromate is produced, an acid chromate being formed by cautious addition of

* From *Nature*.

a solution of chromic acid during the electrolysis.

To attempt to mention, much less to describe, the enormous number of inorganic compounds and elements which have been prepared or isolated by the aid of electricity, would be, in an article such as this, impossible; but sufficient examples have been given to show the importance of electrical processes in this branch of chemistry.

Turning now to organic chemistry, we notice that, although a vast amount of work has been done, it is more of theoretical interest than of technical value. But now that the initial difficulties have been to a large extent overcome, and the manner in which the reactions take place is better understood, it is probable that shortly this branch of manufacturing chemistry will undergo a revolution in the hand of the electrochemist. As a means of synthesis and of proving the formula of substances, electrolysis has been, and is, of great value to the organic chemist. Thus on electrolyzing a solution of an alkaline acetate, ethane is produced; whereas by employment of a succinate, ethylene is formed, a solution of fumaric acid yielding acetylene. These are, of course, simple cases; but even that seemingly unsolvable problem, the constitution of camphoric acid, has been attacked by Walker, and by means of electrolysis of it and its derivatives he has obtained results which must be of great value in ultimately deciding what is the correct formula for this substance.

Iodoform can now be produced in a state of great purity by electrolyzing a solution of potassium iodide and sodium carbonate to which alcohol has been added. On electrolysis, employing electrodes of platinum, iodine is continually set free at the anode, and coming in contact with the alcohol at the moment of its liberation produces iodoform. As the reaction proceeds some of the iodine becomes converted into hydriodic acid, and this combines with the alkali liberated at the cathode, or which has been added to the bath, potassium iodide being regenerated, which by the further passage of the current is again split up. The process is a continuous one, the iodoform being from time to time removed and a further quantity of alcohol, potassium iodide and sodium carbonate added. It is interesting to note that the alcohol can not be replaced by acetone, as in this case only a very small quantity of iodoform is produced. Chloroform and bromoform have not been successfully prepared by this method. Chloral can, however, be produced by electrolysis of a solution of potassium chloride at 100 degrees, to which alcohol is from time to time added.

By the electrolysis of nitrobenzine in a strongly acid alcoholic solution, aniline is produced. If the nitrobenzine is suspended in concentrated hydrochloric acid, ortho and para-chloraniline are formed. By electrolysis under other conditions, azobenzine, hydrazobenzine or azoxybenzine are obtained.

By the electrolytic oxidation of aniline, dye products can be obtained, the nature of which depends upon the solution employed, the strength of the current and the material of the electrode, *e.g.*, if an aqueous solution of aniline hydrochloride, which may be either acidified with sulphuric acid, or be practically neutral, is electrolyzed, platinum electrodes being employed, a green precipitate is produced at the anode, which becomes violet, bluish-violet, and finally almost black, practically the theoretical quantity of aniline black having been formed. If the aniline contain toluidine, then mauveaniline, rosaniline, etc., are produced.

Attempts have been made to obtain alizarine by electrolysis of anthraquinone in strong alkaline solution; indeed, small quantities are said to have been obtained.

It has even been found possible to utilize electricity in the dyeing of cloth. When, *e.g.*, a piece of cloth is soaked in a solution of aniline sulphate and placed between two metal plates, which are connected with opposite ends of a dynamo,

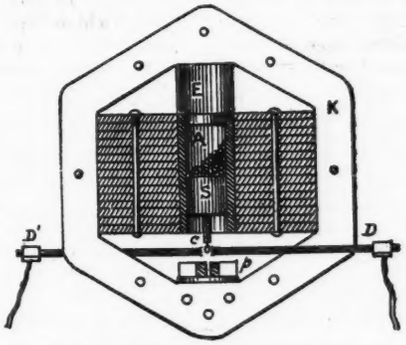


FIG. 1.—MAJORANA'S APPARATUS FOR MAKING ARTIFICIAL DIAMONDS.

and the current passed, the aniline sulphate is converted into aniline black; indeed, by altering the strength of the solution and the density of the current, shades varying from green to deepest black can be produced.

In the case of indigo, the cloth is thoroughly impregnated with a thin paste of indigo-blue and caustic alkali; it is then placed between two metal electrodes. On the current being passed, the insoluble indigo-blue is converted by reduction into the soluble indigo-white, which on exposing the cloth to the action of air becomes again oxidized and the material dyed blue. Patterns may be printed on the cloth by cutting or stamping the plates in relief, or by connecting one pole to a metal plate and the other to a metallic pencil, when patterns, etc., can be readily sketched upon the material (Goppelsroeder).

Such processes as have been described in these articles appear, when seen in print, as extremely simple. Theoretically they may be so; but in practice, the carrying out of these seemingly simple operations is often attended by great difficulties. For example, the temperature must not be allowed to rise too high or fall too low. The quantity of current and its potential require often to be kept within extremely narrow limits, as the following simple example illustrates.

Silver and copper can be separated by means of electrolysis, the silver alone being deposited if a very low current density (.10 ampere) is employed, whereas with a higher density (.50-1.0 ampere) the copper is deposited. Naturally, then, if at the commencement of the operation the higher current density is employed, both metals will be deposited together. Many of the difficulties to be overcome are to a large extent engineering. And it is to a considerable extent due to collaboration of chemists and engineers that the science of electro-chemistry has become what it is.

Electro-chemistry is quite in its childhood, but it is making marvelous and rapid progress. Works dealing with technical chemistry but a few years old require to be revised, owing to the alterations which this branch of chemical industry has brought about.

It is humiliating to realize that in this country there is hardly a book on the subject to be obtained, and in most cases even these are only translations from Continental works. And it is to be feared that unless this branch of chemistry becomes more studied than it has been up to the present, we shall find in the near future that electro-chemistry, both theoretical and practical, is the property of America and the Continent.

ITEMS OF INTEREST.

Judge James M. Thomas, president of the Independent Telephone Association of the United States of America, has been appointed general manager of the toll lines owned by the United States Telephone Company, of Cleveland, Ohio.

The matter of equipment of the elevated lines of the Boston Elevated Railway Company has been definitely settled. The contract for the multiple unit system will go to the Sprague Electric Company and the contract for the motors will go to the Westinghouse Electric and Manufacturing Company. The contracts cover the equipment of 60 cars and involve the expenditure of about $100,000 and $200,000, respectively. The contracts for the car bodies, trucks and air brakes have not been placed as yet.

The New York, Westchester & Connecticut Traction Company, which is controlled by the P. H. Flynn syndicate, has filed a mortgage for $2,500,000. It was issued to the Hamilton Trust Company, of Brooklyn, N. Y. John J. Crennan, counsel for the syndicate, says that it will immediately lay five miles of tracks in New Rochelle, and will extend its Mount Vernon line to White Plains as soon as the necessary franchises and consents are obtained. Mr. Crennan also announced that a line would be built along the Sound as far east as Bridgeport, on which large vestibuled cars would be run.

AMERICAN EXHIBITS AT THE PARIS EXPOSITION.

BY C. L. DURAND.

(Concluded from page 668.)

On the other side of the main passage is the exhibit by the General Electric Company, which is in charge of Mr. J. J. Oolgaardt. Here is to be seen a large model of the Schenectady works, which is represented in miniature with all the details, showing the various shops, railroad tracks, etc. The model is mounted upon a large platform, and is lighted from above, and also from below, the lights being arranged so that all the buildings appear to be lighted from the interior. This model, which has recently been completed, attracts the attention of all the visitors to the section. The remainder of the space is occupied by a number of frames containing large photographs of the company's principal installations in America. The station of the New York Metropolitan, the Redlands Los Angeles plant, that of the Carbide works at Niagara, and the Chicago Metropolitan are shown, with many others, beside views of the lamp and meter factories and the 1,500 horse-power locomotives used on the B. & O. Railroad at Baltimore. Mr. Oolgaardt states that the company has furnished 28 electric locomotives of a similar type to the new Central London Underground System, which is to be in operation within two months. In Paris, eight similar locomotives of 800 horse-power have commenced running on the Paris-Orleans road, which is underground from the Orleans station, in the eastern part of the city, to the Invalides station, at the exposition grounds; four motors are used on each of these locomotives. The company is represented in France by the Compagnie Française Thomson-Houston, which has a large 1,000-kilowatt alternator in the French dynamo room, this being one of the machines which furnish light and power for the exposition. In another section a 500-kilowatt alternator is shown and a number of railway motors; this material has been constructed by the Postel-Vinay Company, which manufactures the apparatus for France. The Compagnie Française Thomson-Houston has a fine office building in Paris where the engineering and designing work is carried on. The company does a large business in France, and has installed traction lines in nearly all the large cities.

The John A. Roebling's Sons Company exhibit in this section is now completed, and shows the different types of lead-covered cables; the interesting feature of the exhibit is a full-sized section of the conduit used on the New York Metropolitan system, with a section of brick-lined manhole. It shows the earthenware conduits for the feeder cable and the connections which are made from the manhole to the main bars of the traction conduit; this contains a double T-rail for the contact plow; the method of rail-bonding is also shown. At the other end of the conduit is another section of manhole, intended to illustrate the method of drawing the cable through the earthenware conduits; to this end a large reel of lead-covered cable is placed above, as well as the windlass from which the rope passes into the manhole over a series of pulleys and is attached to the end of the cable. A large panel in the rear shows a number of cables, rail bonds, telegraph and telephone terminal heads, etc. The company's exhibit in the Metallurgical Building is quite extensive, and shows a great variety of wires and cables. The model of the Brooklyn Bridge, which was to have been mounted above this exhibit and to form one of its principal attractions, was lost on the Pauillac, but a reproduction has been made and is now on its way. The erection of these two exhibits has been carried out under the supervision of Mr. Mitchell, who is the company's representative at the exposition.

The exhibition of the Chas. A. Schieren Company, in charge of Mr. Charles A. Bramm, shows the various kinds of belts made by this firm; the largest of these is a roll of three-ply 72-inch belt, 111 feet long, and a 60-inch belt 120 feet long. Other sizes are shown from 24-inch down to two-inch; samples of wire-sewed and lace-sewed belts are to be seen, also a number of leather-link belts, with an improved type of joint, and an extra-dressed belt of the kind supplied to Russia. A number of tanned hides are shown, also photographs of the factories and the medals received at different expositions. Mr. Bramm states that the company has a large trade in Europe, including Sweden and Norway, England, Russia and other countries.

The Edison Phonograph Company has a display of various types of phonographs which form an attractive exhibit; when the phonographs are working it is surrounded by a large crowd of visitors. The Edison-Lalande battery is shown, and different models of coin-operated phonographs. An interesting feature of the exhibit is a case containing several models of early phonographs, including the original tin foil phonograph made by Edison. The instrument exhibited at the Paris Exposition of 1889 is shown, also a later model. The Edison projecting kinetoscope is also shown. The company is represented at the exposition by Mr. Liepman Kaiser.

The exhibit of the Bullock Electric Company shows a number of direct current motors of different sizes, and motors adapted to crane or press work. A generating set is to be mounted in the exhibit, consisting of a Forbes marine engine and a 20-kilowatt machine. A marble panel switchboard will also be shown. Next to it the Lorrain Steel Company have two trucks for motor cars, each axle carrying a 30-horse-power motor. The first equipments sent over by the company were lost on the Pauillac, but they have been replaced, and the exhibit is practically completed. The E. Horton & Son Company has an exhibit of lathe chucks of various sizes, and next to it is the display of the Norton Emery Wheel Company, in which a revolving panel board has been mounted, driven by an electric motor placed underneath; a Crocker-Wheeler motor of two horse-power operates an emery grinder. The American Tool Works Company and the Shippy Manufacturing Company have exhibits of drill-presses, lathes, etc.

Among the valve exhibits are those of the Asbestos Valve Company, the Chapman, Ludlow, the Stillwell-Bierce & Smith-Vaile, and others. In the latter exhibit is a triple pump driven by a 15 horse-power Thresher motor, also a single jet condenser. Among the exhibits of machine tools may be mentioned those of the Niles Tool Company, the Pond Company, Bement, Miles & Company, and others. Warner & Swasey have an extensive exhibit of tools, and the various punches and stamping presses by the E. W. Bliss Company occupy a large space. A five horse-power motor of the Northern Electric Company's make drives a lathe in the Gisholt Company's exhibit. The Ferracute Company has an extensive exhibit of dies and presses; the Robins Conveying Belt Company has a large conveyer system driven by a Lundell motor. One of the interesting exhibits is that of the Ingersoll-Sergeant Drill Company, which operates an air compressor supplying all the pneumatic tool exhibitors in this section, and also for the operation of a 25 horse-power vertical steam engine which will drive a dynamo used to furnish part of the lighting current for the section. The same company also has a large exhibit at Vincennes. Another important exhibit is that of the Tripler liquid air apparatus, which will be shortly completed.

The United States has also a large space on the upper floor of the Electrical Palace. The National Pavilion, which contains the historical collection, is now finished, and the apparatus has been arranged in the cases and classified. The collection is one of great interest; a full description will be reserved for a subsequent article. It contains apparatus illustrating the progress made in electric lighting, telegraph, telephone, motors, etc. The central room has a set of cases arranged in a circle which contain a number of photographs illustrating the experiments of Professor Henry, besides other historical documents. In the other rooms the cases contain early forms of telegraph

instruments, sounders and printing telegraphs, telephones used by different experimenters, early types of motors and small dynamos, an early form of the Gray telautograph, etc. Among the larger apparatus, which has been installed in a space on one side, have been remarked a model of Franklin's electric machine, a small electric car designed by Sidney H. Short and operated in Denver in 1885, early models of railway motors, an electric car built by Edison, one of the first Edison dynamos, etc. The objects in the collection are numbered, and a complete list has been drawn up by Mr. James Anthony, who has charge of this department, and to whose efficient management the success of the exhibit is largely due.

The exhibits of the various American electrical and mechanical firms occupy the larger part of the gallery which extends along the side of the dynamo room devoted to the foreign machines. They occupy one side of the gallery, leaving a passageway along the inner side, and are provided with a uniform iron railing with arc lamp posts at intervals; there are 11 of these in all, and they carry at the top a bracket on each side in the shape of an eagle, which supports the lamp. The lamps used are of the C. J. Toerring Company's make, and are provided with Holophane globes. The section commences with the exhibit of the H. Ward Leonard Company, in which are seen a number of Carpenter enamel rheostats, motor starting boxes, resistance units and other apparatus. In this exhibit is mounted a switchboard with a number of apparatus, including automatic circuit breakers of different sizes. Next is the exhibit of the Gold electric heater; in the back is a car seat having the heaters underneath, showing the method of car heating; besides this, a number of the heaters in different forms are shown separately, in tube register and stove forms. The Helios-Upton Company has the next space, and shows various forms of arc lamps; in the exhibit is a panel-board showing the various forms of the Hart switch. The exhibit is in charge of Mr. Rosenberg, a member of the H. M. Salmony Company, who represent these two firms in Paris. The exhibit of the Worthington Company, which comes next, is not yet completed, but a number of large photographs of Worthington pumps are to be seen. One of the interesting exhibits of this section will be the printing telegraph apparatus which has been recently invented by Professor Rowland. The apparatus consists of a keyboard resembling a typewriter, from which the message is transmitted to a printing instrument at the distant station; this reproduces it in typewritten form. A number of messages may be sent at once over the same wire. The transmitter and printing apparatus are now being mounted, and the system is soon to be shown in practical operation; its details have not as yet been made public.

The remainder of the space in the United States section is provided with nine double cases arranged at intervals, besides a considerable wall and floor space, which is occupied by a great number of American houses; each of these is represented by a display of apparatus or supplies, or, in some cases, by a panel-board or individual apparatus. The Vulcanized Fibre Company has a panel-board with fibre pieces of different kinds, tubes, strips, etc., adapted for electrical work. A number of manufacturing companies are represented by different forms of telephones; among these may be mentioned the Western Telephone Construction Company, the Telephone Manufacturing Company, the Standard Telephone Company, the Farr and the Pennsylvania companies, and others. Panel-boards are shown by Huebel & Manger and by Partrick, Carter & Wilkins, of electric bells, push-buttons, etc. An exhibit of fuse wire, links and enclosed fuses is shown by the Chase-Shawmut Company. The United States Carbon Company shows samples of battery and electric light carbons. The Eureka Tempered Copper Works has a display of copper brushes, rail bonds, commutator strips, etc. An iron conduit system, with junction boxes, is shown by the Speer Electric Company. The Anderson Manufacturing Company has a series of switches with slate bases, and also a display of line material, such as trolley switches, bell suspensions, etc. The Safety Insulated Wire and Cable Company has different forms of telegraph, telephone and electric light cables. The teleseme system of electric indicators for hotels, offices, etc., is shown by the Hertzog Company, with a number of instruments. The Ironclad Resistance Company has a display of circular rheostats and lever resistance boxes. An exhibit of asbestos pipe covering is shown by the Ambler Company. Mica and micanite in different forms is shown by Eugene Munsell & Company, with a railway motor armature illustrating the method of insulating the slots and body. The American Electric Specialty Company show a number of resistance boxes, heating irons, besides telegraph keys and sounders. The C. J. Toerring Company, in addition to the lamps used to light the section, have a number of arc lamps on exhibition. Among the transformers shown are those of the Pittsburgh Transformer Company and the Lakon Company. The Wagner Electric Company has a three horsepower motor. A number of batteries are shown, among which the Gonda battery is well represented by a number of different forms of cells, and also the Gordon battery with various types and sizes; the Law double-cylinder cell is also represented. Different types of Weston voltmeters and ammeters are to be seen, also the Deshler & McAllister portable photometer. Among the exhibits of carbons for battery and arc lamps may be mentioned those of the Speer, Partridge and National Carbon companies. A number of different tools, gear-wheels, etc., are shown by the Oster Manufacturing Company, the Oneida Church Company, the Geometric Drill Company, and many others. The Carborundum Company, of Niagara Falls, has a display showing a number of wheels of different forms as well as specimens of carborundum in crystals and powder.

VIEWS, NEWS AND INTERVIEWS

The roads of Porto Rico are said to be splendidly adapted for automobiles, and it is expected that a large number will soon be in use on the island.

Owing to the threatened shortage in the water supply, in Brooklyn, N. Y., the water department has denied the application of the park commissioner for the use of water for displays at the electric fountain on the Park Plaza.

During a severe thunderstorm at Hartford, Ct., on June 27, three trolley cars were struck by lightning and the occupants shocked. George Getz, a deaf and dumb man, who was leaning against an iron trolley pole, received a shock so severe that he yelled loudly for the first time in his life.

This novel and suggestive advertisement, the genuineness of which is guaranteed by a contemporary, recently appeared in a Minneapolis paper, under the heading "Wanted — Locomotive Engineer:" "I want a man who can run a Shay Gear Lima engine for logging railroad; I don't want excuses, I want logs. I want a man who can climb into the firebox and caulk his flues with 60 pounds of steam on, and who can 'get there' without having a machine shop under the cab eaves. In short, I want an engineer who will not burn out the telegraph line with complaints to headquarters. Work in Wisconsin. Steady job with adequate pay to the right party."

The intelligence of the members of the London police force has been questioned from time to time, but we can not understand a constable taking a small electric light to be the end of a cigar, says one of our British contemporaries. The case in point was one brought before Mr. Bros, at North London Police Court. Mr. Joseph E. Thornton, of Hillside road, Stamford Hill, was summoned for riding a bicycle at night without having exhibited thereon a light. The defense was that though there was no light attached to the machine, still the defendant had a small electric light in the buttonhole of his coat, which, it was contended, was sufficient to comply with the act of Parliament. The constable admitted that he could see this light some distance off, but said that he thought it was a lighted cigar. The contention that the light was on the man and the man was on the machine did not hold, as the magistrate stated that the act said that the light must be attached to the carriage, and he consequently imposed the nominal penalty of 1s., with 2s. costs.

ELECTRICAL MEASURING INSTRUMENTS.*

BY J. FRANKLIN STEVENS.

In attempting a brief discussion of so broad and comprehensive a subject as that assigned me for this evening, I have been principally concerned in trying to decide just what portion of the general subject I should touch upon and in what manner I could treat that portion briefly, for I can not hope to be comprehensive, and yet have my remarks present a semblance of coherence.

Since we have available a very extensive literature bearing on the subject of laboratory testing instruments, in which can be found descriptions of the instruments employed, their construction, application and approximate laws, I shall pass over that portion of the subject and confine myself to commercial direct-reading indicating instruments, such as are to be found in every day use.

The history of the art embodied in the commercial manufacture of indicating instruments is extremely interesting, but shows many analogies to the development of other branches of electrical engineering, with the single exception that practical data in published form is extremely scarce. Every one entering this field is compelled to master some of the most intricate problems known to the profession, and must learn for himself how best to apply theoretical deductions to practical mechanical devices. Until very recent years, our sole guide has been the study of early and primitive types which in their time were useful and valuable, but which to-day fail to reach the high standard we have learned to demand of an instrument whose function is to indicate the input or output of our many and varied electrical devices. Every new device put before the public has meant a new condition to be met by the instrument manufacturer, requiring of him a new design or modification of an existing design. Two rather recent examples of this occur to me; one, the increasing tendency to employ high voltages in commercial work, reaching frequently 12,000 volts in the case of series constant-current arc light systems and 33,000 volts in long-distance power transmissions; the other, the rapid development of the electric automobile, which requires a volt-ammeter of as high a degree of accuracy as the portable laboratory instrument, yet able to withstand the roughest use ever accorded an instrument of precision, coupled with restrictive specifications as to size and weight. In every instance instrument manufacturers have met the demands made upon them better, I think, than many of our fellow-workers have done in other lines. Much yet remains to be done, and much, I am confident, will be done in the matter of perfecting existing instruments in the near future. Gradually inefficient or unreliable types are being relegated to oblivion, and the remaining ones brought closer and closer to standard uniform construction.

The great majority of measurements required to-day can be made with a voltmeter, ammeter and wattmeter, and, while it might be thought that the wattmeter is merely a combination of the voltmeter and ammeter mounted in one case, this is not true in all classes of measurement. While it is true that the reading of the wattmeter represents the product of the readings of the voltmeter into the ammeter in the case of direct-current measurements, it is not true in the case of alternating-current measurements, save in the very exceptional case of a circuit possessing neither capacity nor inductance or a balance of the two. When either inductance or capacity exist there is a consequent lag or lead of the current wave relative to the pressure wave, and, since the instantaneous readings of the volts and amperes represent the mean effective or virtual values, that is, the square root of the mean square, their product differs from the reading of the wattmeter, which indicates the integrated values of two curves, the maximum and minimum values of which occur at different times. To obtain an agreement between the values obtained by volt-ampere readings and watt readings, it is necessary to multiply the volt-ampere readings into the cosine of the angle of lag or lead, so that the ratio of the watt readings, as given by a properly constructed wattmeter, to the volt-ampere readings gives us the power factor of the circuit, and from the two sets of readings we can readily determine the angle of lag or lead and the so-called wattless current. Probably this is well known to all of you, yet scarcely a week passes but I have to explain the matter to one or more customers who can not reconcile the difference in the two sets of readings and are inclined to believe that some, if not all, of their instruments are indicating erroneously.

Before touching on the different types of indicating instruments which are most commonly found in commercial use, let us consider for a moment the essential requirements of a practical and satisfactory instrument for measuring voltage, current or power. To start with, the instrument must be direct reading. We have no time to-day to convert angular deflections into true values by means of tables of constants, but insist that the pointer shall indicate directly in definite units the value of the passing load or the impressed electro-motive force. We must next be assured of the accuracy of the calibration, and for that depend principally upon the reputation of the maker or check the indications by comparison with a secondary standard. Beyond this we must know that the accuracy of the indications is not affected by the influence of ordinary external fields or by normal variations of temperature, due either to heating within the instrument, by means of the passage of the current to be measured, or to variations in the temperature of the room in which they are installed. All instruments should be mounted in dust-proof cases, and the systems carried in jeweled bearings; the movements of the pointer should be aperiodic or dead-beat, and, so far as possible, the system should contain nothing subject to change or deterioration, and should be constructed so that it will withstand successfully the ordinary rough usage liable to be accorded it in passage. The question of gradual change of accuracy, due to the change in some constituent part of the system, has led me to strongly advocate the use of electromagnetic instruments with gravity control for switchboard use whenever the conditions render them applicable, and I fully expect to see this type of instrument become more popular as its advantages become more widely appreciated. Such a system is not applicable for portable instruments, save the dynamometer system for alternating currents, and even then a spring control must be used; nor is the series electromagnetic ammeter practical above about 1,500 amperes, due to the structural difficulties involved in carrying the busbars directly to the instrument terminals. The one objection most commonly urged against the electromagnetic instrument for direct current switchboard use is the unequally divided scale, for, as a rule, the scale only covers a range starting at 10 per cent of the total up to maximum. In most cases, however, this objection is purely captious, for a switchboard voltmeter is seldom used to indicate more than 10 per cent above or below the normal voltage, and the ammeter indications are of principal importance in the higher ranges to prevent a possible overload of the circuit or generator. In alternating-current circuits an equally divided scale is an impossibility, so why should we sacrifice constancy in direct-current measurements for the sake of an equally divided scale when the lower registers are so seldom used? In portable direct-current instruments the proposition is somewhat different, as we desire to cover the maximum limits of possible measurements on a single-scale instrument; therefore, an equally divided scale is desirable and practically necessary.

Taking up now the different types

* Read before the Electrical Section of the Franklin Institute, Philadelphia, April 24, 1900.

of instruments which are in most common use, we find they may be divided roughly into six classes, depending on the principle by means of which measurements of voltage, current or power are made: (1) the hot wire; (2) the tangent galvanometer; (3) the electrostatic; (4) the dynamometer; (5) the D'Arsonval galvanometer, and (6) the electromagnetic.

The hot-wire instrument is designed to operate by the expansion of a fine wire or strip of conducting material due to the heating produced by the passage of the current to be measured, and, therefore, the indications are proportionate to the square of the current. This type of instrument possesses the advantage of indicating with equal accuracy the current flow on either direct or alternating-current circuits and is independent of the frequency of the circuit or of the shape of the current wave; it is, further, unaffected by the presence of external fields. These advantages, however, are all that can be claimed for this system, and to offset them are many serious disadvantages. Since the instrument operates by virtue of temperature differences, it is extremely susceptible to variations of external temperature, and such variations must be compensated either by mechanical means, which provide for bringing the pointer to zero by increasing or decreasing the tension on the working wire or by providing auxiliary heating strips which are supposed to automatically adjust the tension of the working wire on the general principles of a thermostat. This may seem a small matter to most observers, but to me it signifies an error in principle, and reminds me of one of our early types of arc dynamos which, by reason of incorrect construction, was found to spark badly; so, in place of correcting the design, an air blast was provided to blow out the spark. Another point of objection is the constant change of zero, due to the fact that until the wire has been stretched to its elastic limit it will fail to return to the same point after having been stretched by the heat applied and will always show a slight residual strain. To attempt to correct this prior to installation in the instrument means, judging by my own experience, that at least 90 per cent of the wires will break during the preliminary stretching process, and the remaining 10 per cent will stand but a very slight overload in service. As overloads are quite common, this would constitute a serious objection, for it means the return of the instrument to the manufacturer for the insertion of a new wire and recalibration. Another very serious objection is the amount of current required to operate the instrument. The average resistance of a modern hot-wire voltmeter is four ohms per volt, which means a current flow of .25 ampere. This low resistance effectually bars this type of instrument for accurate testing, since the amount of power abstracted from the circuit to be tested vitiates the accuracy of the results obtained and introduces serious errors, which must be allowed for in all calculations. Recently an attempt has been made to introduce the hot-wire instrument as a shunt ammeter, particularly for alternating-current measurements. As a shunt ammeter the hot-wire instrument is a distinct failure, for, while the manufacturers claim it can be operated on a drop of .3 volt for full scale, my personal experience has shown a drop of six volts to be necessary. On the makers' figures, 300 watts would be required to operate a 1,000-ampere ammeter, nearly .4 horse-power per instrument, while on the sample I have tested 6,000 watts, or eight horse-power would be required. Again, it has been shown that these ammeters when calibrated on direct current are not accurate within 10 per cent when used on alternating currents, unless the reactance in the shunt is exactly equal to the reactance in the instrument, a condition almost impossible to obtain, even with the most careful design.

A modification of the hot-wire system has been proposed, consisting of an enclosed chamber, containing a fixed resistance wire, one end of the chamber, which is made air tight, consisting of a flexible diaphragm operating the pointer through a system of levers. In this case, the heat supplied to the wire by the passing current causes the air in the enclosed cylinder to expand, and, consequently, puts the diaphragm under tension, very much on the principle employed in the aneroid barometer. I find by actual experiment that such a system could be applied to voltmeters, and could be so made that it would be accurate in its indications and would possess a reasonably high resistance. The feature, however, which renders this system impracticable is the slowness with which the readings can be taken. The pointer will not come at rest until the heat supplied the air within the enclosed chamber is equal to the heat radiated by the walls of the enclosing chamber, and from one and one-half to two minutes are required before the pointer will come finally to rest at the part of the scale marked to indicate the impressed electro-motive force. This is true no matter how small the air chamber is made; and while it is possible to shorten this time by carefully covering the sides and one end of the cylinder by a heat insulating jacket, still it can not be constructed so as to give an instantaneous reading, and every attempt to shorten the time by covering the walls of the chamber results in a corresponding increase of the time required for the pointer to come back to zero after current has been shut off. In other words, the instrument is similar in its action to an ordinary thermometer, which, as you know, can not be made to respond instantly to changes of temperature.

Electrostatic instruments, which depend for their action on the mutual attraction of two plates connected to the opposite sides of the line, are still used, but not extensively, for high-tension measurements. They will indicate correctly on either direct or alternating-current circuits, but are limited to measurement of voltage. It is impossible with this type of instrument to obtain a low reading, as the attraction of the plates toward one another varies approximately with the square of the potential difference between them. I say "varies approximately" advisedly, as the capacity of two plates varies directly with the square of the voltage only when the distance between the plates is maintained constant, which in this case is an obvious impossibility. As a rule, these instruments can not be made dead-beat without introducing elements liable to seriously interfere with their accuracy; and, while there are no errors due to temperature changes, and while they are also extremely efficient, requiring no current flow at all, they are affected very considerably by external influences, particularly by static charges, which are almost invariably present in power stations or dynamo rooms, and, as you probably know, it is practically impossible to provide a shield for static effects.

Instruments employing the principle of the tangent galvanometer are still employed, and for certain classes of measurements are extremely useful. They can be particularly recommended for use as ground detectors or differential voltmeters, where the actual value of the indicators is of small moment, the particular object being to show a balance of two opposing voltages or the presence of a ground by deflection. In this system the magnetized needle is suspended vertically, and is acted upon by two equally and oppositely wound solenoids; that is, the solenoids are wound with two wires in multiple and then cross-connected, so that we have two circuits equal in effect but opposite in action. I might say in passing, that if the proper proportions of solenoids to magnetized needle are employed, and the length of the magnetized needle properly proportioned to its area, the tangent galvanometer instrument may be made extremely accurate, and also quite permanent. Care must be taken, however, that under no conditions can the direction of the lines generated by the solenoids oppose the lines existing in the magnetized needle, otherwise, the value of the calibration is almost instantly destroyed.

For measurements of alternating-current voltage, and also for the measurement of the watt output of any alternating current source of energy, the dynamometer system, in one of its many modifications, is unquestionably the best type of instrument that can be used. This instrument indicates directly the mean effective voltage of the line to which it is connected, and is equally accurate for direct-current measurements, provided readings are taken with the direct current flowing through the instrument in one direction, then the direction of the current flow reversed and a second reading taken, the mean of the two readings being the correct value of the impressed electro-motive force. This for the reason that the instrument is extremely susceptible to the influence of external fields. Further, the dynamometer type of instrument is only properly adapted for use in portable instruments. The fact that two readings are necessary on direct current prohibits its use as a switchboard instrument on direct-current circuits, and its delicacy, coupled with its

field of low intensity, and its susceptibility to error, due to the presence of iron in its immediate neighborhood, whether used on direct or alternating-current circuits, renders it impracticable as a switchboard instrument for alternating-current circuits. As an ammeter, it can not be successfully employed for measurements above .5 ampere, due to the difficulty of providing perfectly flexible contacts capable of carrying large currents. When you attempt to convey a current into a moving coil beyond the carrying capacity of a flexible conducting spring, recourse must be had to mercury contacts, and a mercury contact should never be employed in a portable or enclosed type instrument. In the dynamometer instrument great care must be taken to have the moving coil as light as possible; and to render the instrument aperiodic, or dead-beat, an aluminum air vane, moving in a partially enclosed chamber, must be employed. Manually operated brakes acting on the delicate moving system should be avoided, as their continued use results in a serious derangement of the moving parts.

Instruments based on the principle of the D'Arsonval galvanometer are very extensively used to-day for both switchboard and portable instruments on direct-current circuits; they can be calibrated so as to show an equally divided scale, and, if properly constructed, are an extremely efficient instrument. Further, they are very well adapted to the measurement of resistances and grounds. In the construction of this type of instrument the important factor is the permanency of the permanent magnetic fields employed. It is essential, in the first place, that the proper grade and quality of steel shall be employed, which means a steel possessing high permeability and a high degree of retentivity; then this steel must be carefully worked within definite limiting temperatures and must be treated with great care and skill in the process of magnetizing and ageing. Further than this, the moving coil should be extremely light and the whole system carefully shielded that the moving coil will not be robbed of an appreciable number of lines of force, due to the presence of the shielding iron. The greatest field for this type of instrument is in the measurement of heavy currents; that is, for currents of 1,000 amperes and upwards, due to the fact that it can be operated as a shunt instrument, requiring an extremely small drop of potential, full scale being obtained with a drop of from .03 to .05 volt. This means a relatively high efficiency, and, while the instrument does not possess all of the advantages of a series ammeter, yet it is far easier to install, and, where a high degree of accuracy in current indications is not demanded, will be found very satisfactory in practice.

Further than this, the D'Arsonval instrument, which gives deflections directly proportionate to the current flow, lends itself readily to a large variety of measurements, such as determining resistances and measuring the drop of potential from which resistances and grounds may be readily computed. It is, however, a type of instrument which should be handled with great care, as rough handling or the presence of powerful external fields will permanently destroy the accuracy of its indications. Further, since it depends primarily for its continued accuracy on the maintenance of a field of uniform strength, as supplied by its permanent magnet field, instruments of this type should be frequently checked to ascertain whether the permanent magnets have maintained their initial strength.

A great deal might be said on the subject of the last type under consideration, namely, the electromagnetic system, for there are probably more variations in practical construction contained in this type than in all the other types put together; some are good, many very bad. It is, however, unfair to adopt the policy of certain engineers, who unqualifiedly condemn every electromagnetic instrument, solely and entirely on the grounds that they contain a moving mass of iron, which, in their opinion, must render the instrument subject to errors of lag and hysteresis. My practical experience with this type of instrument, covering a great many years, has taught me that it is perfectly possible to so construct an electromagnetic instrument containing a mass of moving iron that error of lag and hysteresis, if they are present, are so small as to be negligible. In order to achieve this result it is necessary, first, to proportion every part of the instrument with reference to all other parts; to carefully shield the instrument from the influence of external fields, and this by means of a shield that will not introduce errors due to its own retentivity. The iron employed should be very small and very light, and should be selected, after careful test, for purity and absence of retentivity. It should then be formed up with care, and so treated that oxidization is practically impossible. The field due to the actuating solenoid should likewise be carefully studied, and should be designed so that the moving iron will at no time be completely saturated, and yet of sufficient strength, in conjunction with the shield employed, as not to permit the indications of the instrument to be seriously influenced by external fields. In no case should two masses of iron be employed, as is common in some types of instruments which depend on the repulsion of a moving vane by a fixed vane of similar polarity, both being energized by the actuating solenoid. It is almost impossible to free double vane instruments from errors of lag or hysteresis, and there is a further tendency for the pointer to stand off zero, due to the residual magnetism mutually induced in the two vanes.

The fact that the instruments constructed on the electromagnetic principle contain no material subject to change or deterioration, coupled with the fact that they can be built solidly and substantially, and controlled by gravity in place of a spring or springs, renders them exceedingly reliable in practice. If their calibration is correct when first installed, there is no reason why the calibration should change with time.

(To be concluded.)

ELECTRIC LIGHTING

The verdict of $150,000 which Paul M. Hertzog recently obtained against the Municipal Electric Light Company for negligence in wiring for electric lights his former furniture store in Brooklyn, N. Y., has been set aside by Justice Scott, of the Supreme Court (see ELECTRICAL REVIEW, June 6, 1900). The defendant put in electric lights for Hertzog in 1892, and early in 1893 the store was destroyed by a fire. It was contended that through defective insulation the electric current had fired the store. The case has been tried four times. Justice Scott says that the evidence failed to show that the defendant company had been unskillful in stringing the wires, and that while it may have erred in judgment as to what was the best method of insulation, that would not be ground to hold it liable for the destruction of the place by fire.

Negotiations have been concluded by which the Edison Electric Illuminating Company, of Long Island City, N. Y., with a capital stock of $500,000, and a bonded indebtedness of $500,000, and the Jamaica Electric Lighting Company, with a capital stock of $200,000, and a bonded indebtedness of $100,000, are purchased by Wilson & Stephens, 41 Wall street, acting for themselves and the interests controlling the New York & Queens Gas and Electric Company. The last-named company, which has a capital stock of $1,000,000 and a bonded indebtedness of $950,000, operates the Flushing, College Point and Whitestone electric properties. It is understood that the plans of the owners of the various properties embrace a general consolidation into a new corporation. If these plans are effected the new company will control all the electric lighting of the borough of Queens, excepting the district in which the Rockaway company operates, which is so remotely located as to make it inexpedient to operate it from a general station. The transaction explains the stories that originated about two months ago that the Consolidated Gas Company of New York city was going to buy the Long Island City and Jamaica Electric Companies. President H. E. Gawtry, of the Consolidated Company, is a director of the New York & Queens Gas and Electric Company.

Incandescent Lamp Makers Meet.

On Friday, June 29, many of the manufacturers of incandescent lamps from various parts of the United States met in New York city and discussed matters pertinent to the present situation of this industry.

OPERATING WORK AS A FEATURE OF ELECTRICAL LABORATORY TRAINING.*

BY WILLIAM S. ALDRICH.

In the representative institutions the engineering courses are now so organized that the junior student enters the engineering laboratory fresh from work in the physical laboratory. Advanced work along similar lines is carried on in many cases after the student has entered upon his professional studies. The earlier training is chiefly by way of illustration and demonstration, familiarizing the student with the phenomena, principles and laws of physics. The later training acquaints the student with some of the exact methods of modern experimental work. In consequence of such work, the engineering student should early assume toward all phenomena and problems in the realm of physics that attitude so characteristic of the scientific mind. Granting its thoroughness there is less necessity for attempting similar training in the engineering laboratory. More time is therefore available for developing the latter along engineering lines.

The work of physical and of engineering laboratories naturally overlap each other. No hard and fast line can be drawn between them. It becomes daily more impossible to define clearly their respective limits with each advance in physical science and growing industrial applications of the same. In the engineering laboratory are investigated the properties of water, steam, gas and electricity, with special reference to their industrial applications; the chemical, physical, mechanical, electrical and magnetic properties of materials as the case may require; the functional relations of mechanisms, machinery and prime movers, and their performance in detail or in the aggregate.

The bearing of these considerations upon electrical laboratory training is obvious. Preceding experimental work with new electrical appliances or processes there should be carefully arranged work along the following lines: Study, inspection, illustration and demonstration, operation. By thorough study of actual and typical appliances, the necessary preliminary electrical and mechanical data are secured. By inspection the student is assured of the electrical, magnetic and mechanical condition of the apparatus essential for successful operation of the same. By way of illustration and demonstration he is familiarized with the phenomena and principles underlying the functional working of apparatus and the handling of instruments and circuits. By operation the student acquires that familiarity, facility, confidence and resourcefulness so essential for the satisfactory handling of electrical circuits and appliances.

Training in handling electrical machinery is quite as essential as training in electrical measurements. The one should be done and the other not left undone. If, with all his familiarity with galvanometer work, the young electrical engineer is left to the mercy of the wireman or the operating engineer his laboratory training has been incomplete. A knowledge of the behavior of electrical machinery and confidence in handling electrical circuits is becoming more necessary with each widening use of electricity. The utilization of alternating currents and the operation of alternating-current machinery constitute to-day a most interesting and important field, one with which the electrical student can not become too familiar. It is the result of experience that students who have been given a course of electrical laboratory training involving study, inspection, illustration and operation have a better understanding of testing work than if they had been put at once into the latter without attention to the former.

* Abstract of a paper read before the Society for the Promotion of Engineering Education, New York Meeting, July 2-4, 1900.

THE STEAM TURBINE.*

BY PROFESSOR R. H. THURSTON.

An apparently important, and, to the writer, at least, new, fact in the operation of the steam turbine is revealed by experimental investigations in progress for some time past in the laboratories of Sibley College, with both saturated and superheated steam. Contrary to the usual theory of that apparatus, it is found that a very substantial gain may be had by the use of superheat, not only in efficiency, but also in capacity.

The steam turbine is not subject to that form of waste known as "initial" or "cylinder" condensation which adheres to every piston-engine as a consequence of the large fluctuations of temperature which accompany the variations within the cylinder between boiler and condenser pressures, and which, with the best of engines employing saturated steam, amount to 10 or 20 per cent and to a multiple of such figures for small machines. The interior surfaces of the turbine, in steady working, remain at precisely the same temperatures and absolutely without those fluctuations which produce waste in the reciprocating, and in the other forms of rotary engine. As it is to reduce this particular waste that superheating is employed, ordinarily, there would not be expected to be found any other gain by its use in the steam turbine than that increase of thermodynamic efficiency which is due to the widened range of temperature, in this case amounting to about one-tenth of one per cent per degree of superheat. Investigations by Messrs. Schieren and Thomas, above alluded to, show, on the contrary, a gain of about one per cent for each one and two-thirds degrees centigrade, three Fahrenheit degrees, of superheat and the remarkable and unexpected result of an increase in the capacity of the machine of about one hundred per cent by the use of but 20 degrees centigrade, 37 degrees Fahrenheit, superheat. The "water-rate" of the turbine, a La Val machine of 10 horse-power as rated, decreased from about 21.7 kilogrammes, 48 pounds, to 1.99 kilogrammes, 44 pounds, with pressure rising from three atmospheres to eight, with a two-thirds vacuum, and with saturated steam; while the figures fell off about 12 per cent with superheating, rising to a very moderate maximum as above. Deduced to thermal units per horse-power per hour, the same effect appears in a very similar proportion. The causes of the gain in thermodynamic efficiency and of capacity are presumably identical—the extinction of the friction wastes due to the retardation of the current of fluid traversing the passages of the turbine by concurrent resistances coming of the weighting of the current of steam with drops and mist and the adherence of moisture in mist, drops and even streams, very probably, to the walls of the steam passages of the turbine. The phenomenon will, however, be the subject of extended investigation in the course of the work in research constantly in progress and a way will probably be found of precisely identifying the cause and determining the laws governing its action in the production of these variations of efficiency and capacity. That this apparently obvious explanation is the correct one and, certainly, that the gain is not due to any such action as produces the remarkably beneficial effects observed in the reciprocating engine, is tolerably well indicated by the fact that the gain, in this case, by superheating, is substantially proportional, so far as here carried, to the amount of superheat and the graphic log shows a straight line of decreasing consumption of steam.

* From *Science*.

Mr. Geo. P. Roux, of the electrical engineering firm of Delaporte & Roux, Havana, who has been visiting the United States, returned to Cuba last Saturday.

A New Wire for Trolley, Telephone and Telegraph Lines.

A new line wire has recently been placed upon the market by the Bridgeport Brass Company, which first produced, perfected and named hard-drawn copper wire. It is called by the trade name "Phono-Electric," and is an exceedingly high-grade wire, designed to meet the conditions imposed upon line wires by the emergencies of every day service.

This high-grade wire is perfectly homogeneous both in its mechanical and molecular structure, and does not depend upon a hardened skin for its strength as do other drawn wires. A series of tests were made on this point by removing successive strata from the surface of the new wire and its tensile strength was found to be uniform throughout its whole diameter. Hard-drawn copper wire was subjected to the same treatment and it was found that once the skin is removed or injured in any way, the strength of the wire is reduced to that of ordinary soft copper.

This homogeneity of the new wire gives it a tensile strength, the manufacturers claim, for the various sizes of wire, from 40 to 45 per cent greater than that of hard-drawn copper wire, as shown by the following table:

No. B. & S. gauge.	Breaking weight per pound.	Tensile strength per square inch.
0000	11,460	68,780
000	9,140	69,180
00	7,400	70,620
0	6,300	75,830
1	5,250	79,670
2	4,180	80,000
3	3,360	81,080
4	2,700	81,150
5	2,080	81,190
6	1,680	81,280
7	1,350	82,380
8	1,075	82,700
9	850	82 460
10	685	83,810
11	545	84,060
12	420	83,700
13	340	83,390
14	270	83,710
15	220	85,210

Equally important with tensile strength in a wire is the power of enduring severe strains without taking a permanent stretch, thereby weakening the wire for future emergencies. A set of comparative tests on this point shows the new type of wire to have an elastic limit about 40 per cent greater than that of hard-drawn copper wire.

Wire.	No. B. & S. gauge.	Elastic limit pounds per square inch.
Hard-drawn copper	00	41,775
"Phono-Electric"	00	57,860
Hard-drawn copper	0	39,645
"Phono-Electric"	0	55,195

"Phono-Electric" wire is exceedingly tough, and is claimed to resist bending, kinking, wrenching, sudden blows and slow distortions much better than hard-drawn copper or any substitute.

In electrical railway work the trolley wire not only has to stand the mechanical strains of friction and hard pounding, but the passage of the trolley wheel is accompanied by small arcs, set up between wheel and wire. These burn and roughen the surface and anneal parts of its surface. If the wire is ordinary, hard-drawn copper, the hardened skin is destroyed and the wire thus weakened rapidly succumbs. This is the secret of the frequent breaking of the trolley wire at curves where there is heavy service, arcing being established by the flange of the trolley wheel.

"Phono-Electric" is free from this serious difficulty, for it does not maintain an arc readily, and does not anneal. Its fusing point is high and it is free from constituents easily vaporized, hence does not furnish enough metallic vapor to keep an arc going.

Some special experiments were carried out with hard-drawn copper and "Phono-Electric" wire to show the annealing effect of arcing. Samples of Nos. 00 and 0 wire of each kind were exposed to severe arcing for a considerable time with the voltage kept constant, and all the samples treated alike. The samples were then carefully measured for their tensile strength with the following result:

Wire.	No. B. & S. guage.	Original tensile strength, lbs. per square inch.	Tensile strength after arcing, lbs. per square inch.
Hard-drawn copper	00	52,000	43,680
"Phono-Electric"	00	73,500	73,450
Hard-drawn copper	0	54,000	46,440
"Phono-Electric"	0	76,500	76,430

The new wire does not corrode or rust. For trolley wire in hard use, for long and difficult spans, and for telephone and telegraph lines in exposed and troublesome places it is highly recommended.

Alternating-Current Arc Lighting.

The growth of systems for arc lighting by alternating currents has been distinctly noticeable of late, since the introduction of series systems employing enclosed lamps. Of these the most ingenious is that of the Manhattan General Construction Company, of Newark, N. J. A single-phase source of supply (which may be one phase of a polyphase system) is used and the current to the series of lamps is passed first to a reactance coil suspended so as to embrace the middle part of a frame or core of laminated iron shaped like a letter E laid on its side. The coil is counter-balanced by a sort of scale-beam lever. When current is turned on the system, the coil tends to move into a position, determined by the counterbalance weight, such that a definite flow of current passes through it and the circuit of lamps. Variations in the resistance of the circuit are promptly met by motions of the coil, and thus the current flow in the circuit is maintained steady although the source of supply is of constant voltage. The system has been very successful in practice.

Attendants at the Northwestern Convention.

Among those in attendance at the convention of the Northwestern Electrical Association, held at Waupaca, Wis., last week, were the following:

C. L. Dressler, Chicago.
B. B. Downs Minneapolis
J. B Coale. St Louis.
A. F Hammacek, Sturgeon Bay, Wis.
Thos R Mercien and Son, Milwaukee. Wis.
Guy V. Williams and Wife, Minneapolis.
F. A. Copeland, La Crosse.
C. W. Bacon and Wife, Chicago.
Thos. G Grier. Chicago.
H Almert, Chicago
G. S Searing and Wife. Chicago
W E.Smith, Columbus, Wis.
W. W. Bean, St Joseph, Mich
J H. Wolff, Chicago.
G. E. Varney and Wife, Indianapolis.
Miss F. Bissicks, Chicago.
Miss J. Bissicks, Chicago.
Miss B. Bissicks. Chicago.
Miss C. Packard, Warren, O.
W. D. Packard, Warren O.
H. B. Kirkland, New York.
L K. Cushing, Chicago.
Wm H. Edgar, Chicago
C. Cuno, Oconomowoc Wis.
Frank McMaster, Chicago.
J. H Cooke, Chicago.
F. L Merrill, Chicago.
W. P. Bragg and Wife, Monroe Wis.
W. W. Low and Wife, Chicago.
R H. Watson. Chicago.
Fred H. Alden and Wife, Chicago.
W. E. Keily and Wife Chicago.
F. L. Perry. Chicago.
A. Smith and Wife, Milwaukee.
W. R Pinckard and Wife, Chicago.
J. H Pomeroy and Wife, Chicago.
W H. Schott, Chicago.
L E. Kerns, Madison.
Wm Goltz and Wife, Chicago
J. V. S Church, Chicago.
T. F. Grover and Wife. Fon Du Lac, Wis
Lincoln Raindard and Wife, Green Bay, Wis.
A. Meinema, Chicago.
F. E. Hatch. Green Bay, Wis.
P. A Rid and Wife, Green Bay. Wis.
G. M. Dold and Wife, Green Bay, Wis.
P. L. Utley, Grand Rapids, Mich.
C. M. Dougherty. Grand Rapids, Mich.
R F. Kountz Neillsville Wis.
O. C. Little, Menasha
B V Swenson, Madison.
A. W. Richter, Madison.
H C. Higgins and Wife, Marinette, Wis
Mrs. Thos. Higgins, Neenah, Wis.
Geo A Davis, Neenah, Wis.
Mr. and Mrs E L. Debell, Sheboygan, Wis.
C T. Gage, St Paul.
Thos. James, Milwaukee.
W. H. Colman, Chicago.
Pliny Norcross. Janesville.
Robert S. Givins, Chicago.
Frank E. Colbert, Chicago.
L. W. Burch and Son, Madison.
F Raymond, Chicago.
Thos. Ferris, Chicago.
Robt. L. McOuat and Wife, Indianapolis.
M B. Kitt. Minneapolis.
D. T. Wallace, Chicago.
F A. Cheney, Chicago
Wallace O'Connor, Chicago.
J Scribner, Chicago.
W. W. Gusse, Chicago.
H. D. Goodwin, Milwaukee.
Geo. B. Foster, Chicago
Louis A Ferguson, Chicago.
G R. Newcomer, Cleveland.
A. O. Kuhmstead, Chicago.
A. L. Searles, Chicago
O. D. Pierce, Shelby.
Wm. West. Shelby.
T. S. Pamperin, Oconto.
W. R. C. Smith, Chicago.

An Independence Day Souvenir.

With its usual good taste and skill in selecting things ingenious, the American Electrical Works, of Providence, R. I., is out with an appropriate and patriotic souvenir of the Fourth of July. The souvenir carries a flagpole with a flag which may be lowered and raised, and is sent with the compliments of Mr. Eugene F. Phillips, general manager.

Mr. A. C. Garrison, of the Columbia Incandescent Lamp Company, St. Louis, Mo., was a New York visitor last week attending a meeting of the incandescent lamp manufacturers. Mr. Garrison believes that the demand for incandescent lamps this year will be the largest in the history of the industry. His own company was never busier, and is now better equipped than ever for taking care of the wants of its customers.

The New York & New Jersey Telephone Company has declared a regular quarterly dividend of one and on-half per cent, payable July 14 to stock of record July 5.

The Prince of Wales on June 27 opened the Central London Electric Railway. The line is six miles long and has thirteen stations.

New Types of Automatic Circuit Breakers.

While the circuit breaker is apparently an exceedingly simple accessory of an electric plant still it has required for its proper development a high degree of skill and has evolved through a large number of less perfect states to its present highly satisfactory condition. The illustrations herewith represent three types of circuit breakers, embodying a number of new features of importance, which are manufactured by the General Incandescent Arc Light Company, New York city. The contacts, as may be seen from inspection of the illustrations, are of the laminated type and are protected by three shunts, one opening after the other, and a final carbon break of great length. In the case of 500-volt railway panel switches, two long carbon breaks in series are provided. The circuit breakers are made so that both the thrust of the laminated contacts and the action of gravity tend at all times to open them. The contact plugs upon which the laminations make connection are parallel to the face of the switchboard, so that in transferring the instrument from its template to the board it is not liable to be gotten out of line and have its contacts put out of adjustment.

Fig. 1 represents a type of single-pole circuit breaker for railway use working up to 500 amperes at 500 volts. In the double-pole type of instruments, such as is shown in Fig. 3, each side of the circuit is independent and has a separate latch, hence each side is closed separately and if an overload condition exists when it is attempted to close the second side of the circuit the first one opens. This feature makes it unnecessary to provide a switch in circuit with this type of circuit breaker as has heretofore usually been done.

There are no springs used in the adjustment of the instrument. Its action is by lifting a soft iron core against the action of gravity—a construction which is claimed to allow a great range of adjustment, and one that remains constant under all conditions. The sizes of the parts of these instruments are designed with reference to a current-carrying capacity of 1,000 amperes per square inch, and are finished in polished copper. The current-carrying parts themselves are made of hard drawn copper, and the whole instrument is handsome and substantial in appearance.

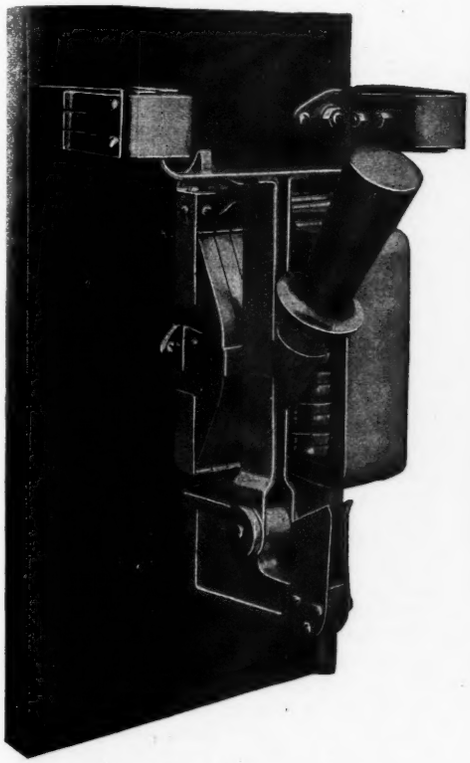


FIG 1.—SINGLE-POLE AUTOMATIC CIRCUIT BREAKER FOR RAILWAYS.

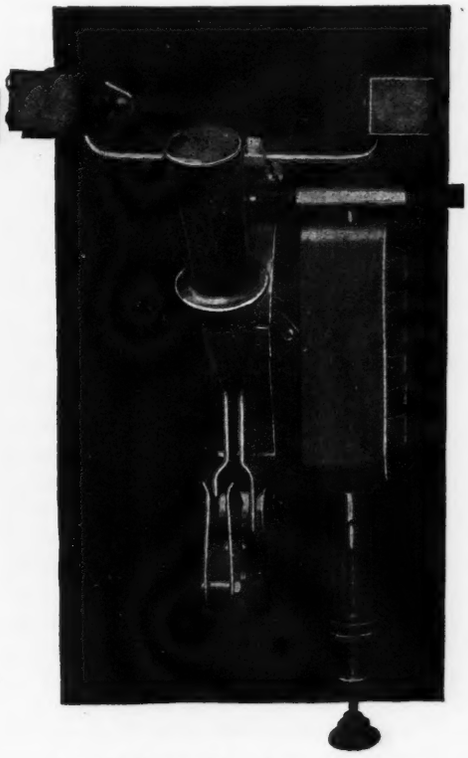


FIG. 2.—SINGLE-POLE AUTOMATIC CIRCUIT BREAKER FOR RAILWAYS.

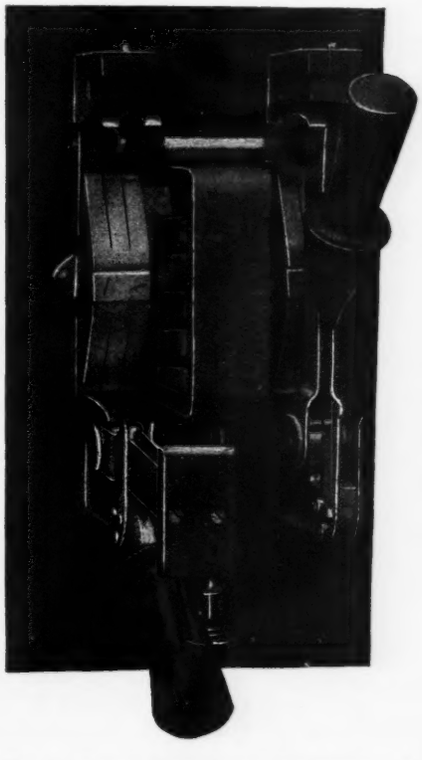


FIG. 3.—DOUBLE-POLE AUTOMATIC CIRCUIT BREAKER.

Wall Street and the Electrical Stock Market.

Various influences combined to cause a quite general advance in the stock market during the current week. The trouble in China, the forthcoming Democratic Convention and other circumstances, which, as a rule, control the stock market, in theory produced little effect. The market closed the week dull with prices materially depressed.

On the New York Stock Exchange General Electric closed the week at 127¼ bid and 128 asked, indicating no change for the week. The Metropolitan Street Railway, of New York, closed at 146¼ bid and 146¼ asked, a loss of ¼ point for the week. The Third Avenue Railway, of New York, closed at 110 bid and 112 asked, a gain of 1 point for the week. The Brooklyn Rapid Transit closed at 54 bid and 54¼ asked, a gain of three points for the week. The Manhattan Railway, of New York, closed at 86¼ bid and 86¾ asked, a gain of 2 points for the week.

On the Boston exchange the American Bell Telephone closed at 300 bid and 310 asked, a gain of 5 points for the week. The Erie Telephone closed at 96 bid and no asked price, showing no change for the week.

On the Philadelphia exchange, Electric Storage Battery common closed at 67 bid and no asked price, a loss of 3 points in the bid price for the week. The Union Traction closed at 37¼ bid and 37½ asked, a loss of ⅛ point for the week. Electric Company of America closed at 9⅜ bid and 9½ asked, a gain of ¼ point for the week.

On the curb or outside market in New York the Electric Vehicle closed at 15½ bid and 17½ asked, a loss of 3½ points for the week. Electric boat closed at 12 bid and 14 asked, a loss of 2 points for the week.

Wall street, June 30.

TELEPHONE AND TELEGRAPH

By October 1 of this year, Detroit, Mich., with a main office and six branches, will have the fourth largest telephone system in the United States, numbering 13,000 subscribers. The three largest telephone exchanges in the United States are New York, 45,000; San Francisco, 18,000; and Cleveland, $15,000 subscribers. The ratio of population in Detroit is only exceeded in number of subscribers in the United States by San Francisco; in the world, by Stockholm.

United States Consul Worman reports from Munich, Germany, that a syndicate has just been formed under the auspices of the Bank of Darmstadt, to bring into practical use certain telephone improvements that have been tested in Government offices. These inventions are to make it possible to retain the spoken word and to repeat it as freely as desired; to use the same wire for simultaneous conversation by different parties; to repeat the same conversation at various points; and to strengthen the sounds so as to make the long-distance telephone operate with better results.

The annual meeting of the stockholders of the Michigan Telephone Company (Erie system) was held at Detroit on June 23 and was well attended by stockholders residing in Michigan and the East. The following board of managers was elected: Charles E. Adams, Lowell, Mass.; Frederick A. Farrar, Boston, Mass.; Frederick A. Forbes, Detroit, Mich.; Charles J. Glidden, Lowell, Mass.; William J. Latta, Philadelphia, Pa.; Martin Maloney, New York; Hugh McMillan, Detroit, Mich.; Charles S. Tuckerman, Boston, Mass.; Thomas Sherwin, Boston, Mass. The board organized by the election of Charles J. Glidden, president; Charles E. Adams, H. J. Pettingill, vice-presidents; George B. Perham, secretary; Charles A. Grant, treasurer.

According to President Glidden, of the Erie Telephone System, the cost of development of the Bell Telephone properties will be at the rate of $50,000,000 annually from now on. Of this amount the Bell subsidiary companies will probably furnish by increase of capital stock or bond issue, about $15,000,000 annually leaving $35,000,000 to be supplied by the American Telephone and Telegraph Company, owners of a controlling interest in the subsidiary companies. Of the $15,000,000 the Erie system supplies $6,000,000 annually, the Central Union $3,000,000, the New England $2,000,000 and the remainder is divided among four or five companies, such as the Cumberland, Southern Bell, Missouri & Kansas, Chicago Telephone Company and the Pacific Coast Telephone companies.

As noted in the ELECTRICAL REVIEW last week, the Michigan Telephone Company, on June 22, laid a new submarine telephone cable from St. Ignace to Mackinac Island, a distance of four and one-half miles. The new cable has eight pairs of conductors, two pairs being of 14 gauge and the balance being of 16 gauge. The cable was made by the Simplex Electrical Company, of Boston, and the work of laying it was in charge of the Western Electric Company, of New York and Chicago. The cable lands on Mackinac Island, on the same spot where the British troops landed on July 17, 1812, and on this spot informal exercises were held when the cable was laid, speeches being made by President Charles J. Glidden, Vice-president Adams and General Counsel Morgan, of the Michigan Telephone Company, Mayor Bailey, of Mackinaw Island, and Mayor Brezette, of St. Ignace. The cable was carried on two large lighters which were pulled across the straights by two tugs. The work of laying the cable was watched from the deck of the steamer by a large party of telephone men. Only one hour and forty minutes was occupied in stretching the cable from land to land, and within five minutes of the time the cable reached the shore, connection was made across the straights. Lunch at the Lake View Hotel and drives around the island followed, after which the party left for Detroit. The heavy tourist season at Mackinac opens about July 1, so that the new cable, furnishing connection with the Michigan Company's new circuits from Marquette to Grand Rapids and Detroit, and also furnishing service for the numerous Chicago people who spend their Summer at Mackinac, was laid just in time to catch the heavy season's business.

President William J. Latta, of the Telephone, Telegraph and Cable Company of America, has issued the following circular to stockholders: "Since the charter, your management has acquired or constructed and now controls the organizations of telephone companies in 12 states and their large cities, with plants as follows: Number of exchanges, 362; exchanges in construction, 10; number of telephones in use, 128,000; awaiting connection, 17,000; miles of wire, 204,000; miles of poles, 20,000. While your company has not had the benefit of a full year's operation of the properties which it now owns or controls, the present returns indicate that the earnings will aggregate 10 per cent upon the capital invested. By resolution of the board of directors an assessment of five per cent, being $2.50 per share, on capital stock, is now called for, payable on or before July 30, 1900. The books close on July 25 and open August 2, 1900."

Electricity in the United States Navy.

The Marine Review Publishing Company, of Cleveland, Ohio, will soon issue from the press the fifth annual edition of the "Blue Book of American Shipping," a marine and naval directory of the United States. The following is taken from the introduction to the 1900 issue of this valuable annual:

Immense strides have been made in the application of electric driving power for auxiliary machinery. The cautious experiment of electrically driven turret-turning machinery on the Brooklyn, of chain ammunition hoists on the Puritan, the system of blowers and exhausters on the Wilmington have all been grouped on the Kearsarge and Kentucky. These two battleships have more of their auxiliary machinery driven by electric power than any other warships afloat. Indeed, the only limitation for its employment to all auxiliary machinery is the time necessary to train the men to care for the electric plants. The battleships Kearsarge and Kentucky are lighted under peace and battle conditions by electricity; four searchlights are operated; the Ardois signal set is operated for night signaling and also various means of interior communication within the ship, such as battle and range order indicators, electric propeling and steering engine telegraphs, revolution and helm angle indicators; truck lights and the ship's running lights are operated and also the portable diving lantern; the two turrets, containing the 8-inch and 13-inch guns, are rotated, the 13-inch guns elevated, ammunition hoisted for both 8-inch and 13-inch guns, rammers of 13-inch guns operated and special ventilation provided to blow gases out of bore of 8-inch and 13-inch guns; 10 endless chain ammunition hoists, two winch type of hoists, six deck winches and two winches of a compound geared type are moved by electricity. These battleships represent the intermediate stage between steam and electrically-driven auxiliary machinery. The use of electricity results in an economy of coal consumption. The experiments in wireless telegraphy demonstrated the feasibility of communication from ship to ship, the range of intelligible messages depending upon the height of the sprit upon the masthead. The elimination of interference when more than one message is sent is yet to be accomplished. It is possible for an enemy within the range of communication by also sending messages to entirely confuse the receiver. However, imperfect as it is, wireless telegraphy has a distinct field of usefulness.

CORPORATION NEWS

TRENTON, N. J.—The Standard Pole and Tie Company has been incorporated to deal in telegraph poles and railway ties.

PERU, IND.—The City Lighting Company, of Peru, has been formed. Capital stock, $25,000; directors: Samuel V. Perrott, Henry C. Ulen, Jr., and Albert G. Perrott.

DENVER, COLO.—The Colorado Telephone Company has increased its capital stock from $1,500,000 to $3,000,000. The proceeds from the sale of stock are to be used for new extensions.

NORTH SALEM, N. Y.—The North Salem Telephone Company has been incorporated; capital, $500; directors: H. Hobart Keeler, Earle C. Bacon, Alfred Howe and David P. Vail.

UTICA, N. Y.—The Utica Fixture Company has been incorporated with a capital of $12,000 to manufacture gas and electric light fixtures. The directors are E. J. Milspaugh, A. C. Sieboth and Joseph Rudd, of Utica.

MENDEN CENTRE, N. Y.—The Centre Telephone Company has been incorporated to operate in Menden Centre, Rochester Junction and Honeoye Falls; capital, $600; directors: Edward P. White, B. H. Cole and Albert A. Lord, Menden Centre.

GREENSBURG, IND.—The Decatur County Independent Telephone Company has been incorporated at Greensburg with $30,000 capital. It will fight the Bell system, against which there is considerable opposition on account of its high rates.

MASONTOWN, PA. — The Masontown Electric Light, Heat and Power Company, of Masontown, Fayette County, has been incorporated. Capital stock, $10,000; directors: Clarence K. Hartley, William C. Blackshere, Masontown; Charles A. Hartley, Ceylon, Pa., and Thomas L. Collier and Robert W. Playford, of Uniontown.

NEW BRIGHTON, N. Y.—The Richmond County Power Company, of Borough of Richmond, has been incorporated to supply electricity for producing light, heat and power; capital, $500,000; directors: Samuel Thomas and William E. Findley, New York city; Morgan L. Ryan, New Brighton; Frederick T. Lewis, Arthur B. Proal, Jr., Norman P. Findley and J. H. Swinarton, West New Brighton.

BOUND BROOK, N. J.—Schedules of the C. C. Chemical Company, manufacturer of electric fuses, whose office was at No. 261 Broadway and factory at Bound Brook, N. J., and which has been put in bankruptcy by creditors, show liabilities of $29,629, of which $11,000 are secured by mortgages, and assets of $15,535, consisting of cash in bank, $292; stock in trade, $390; materials, $2,580; machinery and plant, $11,539; book accounts, $734; also real estate at Bound Brook, where the factory is, but value not given.

CORTLAND, N. Y.—The Cortland Home Telephone Company, of Cortland, has filed, with the Secretary of State, a certificate of incorporation. It is organized with a capital stock of $7,500, to operate in Cortland and Homer. The directors are Charles D. Vernoy, Willard M. Jones, George J. Mayer, William Marvin, Calvin P. Walrod, Herbert L. Smith, Howland L. Davis and Leland G. Foster, of Cortland, and William H. Foster, of Homer.

PENN YAN, N. Y.—The Yates Electric Light and Power Company, of Yates County, with a capital of $300,000, has been incorporated with the Secretary of State. The company will supply electricity for producing light, heat and power for the village of Penn Yan and the towns of Jerusalem, Milo and Benton. The directors are: Henry B. Pierce, Walter Cox, Henry T. Howell, Frederick P. Delafield, Frederick W. Longfellow, of New York city; Cassius L. Haskell, of West New Brighton.

Editors in Saratoga.

The world-famous "Saratoga Limited" train resumed service last week between New York city and Saratoga Springs. Its speed was over a mile a minute the greater portion of the way. The electric block signals of the New York Central Railroad should receive a good share of the credit for the excellent arrangements that prevailed on the inaugural trip. There is probably no busier piece of railroad track in the world than that between Albany and New York, and yet another speedy courser along the metals was added on Saturday, June 23, and ran through to Troy, N. Y., without stopping at a single station, at a speed that rushed it into Troy three minutes ahead of time. From Troy to Saratoga Springs the train passed over the Delaware & Hudson Railroad. This company's oiled roadbed and freedom from dust received praises from all.

The guests consisted of a number of newspaper men and their wives, accompanied by railroad officials, including Mr. George H. Daniels, general passenger agent of the New York Central; Mr. J. W. Burdick, general passenger agent of the Delaware & Hudson, and Mr. C. R. Wager, superintendent of the Pullman company, and their associates.

The citizens of Saratoga, having been properly warned, were ready to receive the special train and its passengers, and to the number of 3,000 turned out and welcomed them with a brass band and a squad of policemen, headed by the president of the village. The hotel proprietors of the United States, Grand Union, Windsor, American, Worden, and others extended the hospitality of the city to the visitors. In the evening a reception was held in the parlors of the Grand Union, and the Saratoga Limited Club held its annual meeting, presided over by Mr. Daniels, who was again elected president. A number of humorous, eloquent and interesting addresses were delivered by the newspaper orators and were responded to in the same strain by the president of the village and the versatile representative of the railroads and hotels. The party returned to New York city Monday morning.

Praises and congratulations were unanimously extended to the railroad officials for this modern example of luxurious and fast traveling, and to the people of beautiful Saratoga Springs for the many courtesies extended. It was voted to hold another meeting of the "Saratoga Limited" Club next year, and, as the ladies were included this year, a committee of five ladies was added to the executive committee to plan for proper ceremonies in 1901.

Among the newspaper people in attendance were: James R. Seavey, New York *Sun;* F. M. Munroe, Brooklyn *Life;* Louis Wiley, New York *Times;* R. K. Munkittrick, *Harper's Weekly;* J. C. Garrison, New York *Press;* W. J. Bois, *Evening Post;* James Martin, New York *Tribune;* H. D. Vought, New York *Commercial;* H. L. Bridgeman, Brooklyn *Standard-Union;* Gilbert Evans, Brooklyn *Eagle;* W. J. Merrill, *Judge;* C. W. Stoax, *Puck;* Hillary Bell, *New York Press;* Arthur A. Parks, *Evening Telegram;* H. E. Milhollen, *Commercial Advertiser;* J. J. Burns, New York *Morning Telegraph;* Charles F. Speare, *Mail and Express;* S. W. Taylor, *Rider and Driver;* Charles W. Price, ELECTRICAL REVIEW; William Berri, Brooklyn *Standard-Union.* Nearly all the gentlemen were accompanied by their wives.

At several points, both up and back, the time made was considerably better than a mile a minute. There was a slight delay in changing engines at Troy going up; it is expected, however, that the time of making this change will be reduced to two minutes. The best time heretofore recorded, it is stated, is two and one-half minutes.

Through the courtesy of the American Telephone and Telegraph Company and the Hudson River Telephone Company, the use of the long-distance telephone lines was extended to the party and was greatly appreciated by the newspaper men and railroad officials during their stay.

INDUSTRIAL NOTES

The Stow Manufacturing Company, Binghamton, N. Y., is soon to place upon the market a new series of direct-connected motors.

John T. McRoy, 302 Broadway, New York, makes the pertinent suggestion that McRoy conduits are surrounded by economy, not concrete.

The Ohio Electric Works, Cleveland, Ohio, are manufacturing a ceiling fan for operation by batteries. This is claimed to be the only apparatus of the kind yet made.

The Viaduct Manufacturing Company, manufacturer of telephone apparatus, Baltimore, Md., is represented in New York and vicinity by David Chalmers, 136 Liberty street.

The Warren Electric Manufacturing Company, Sandusky, Ohio, maker of the Warren alternators, is having a season of unusual activity and its shops are operating under a great pressure of orders.

The Socket Extension Tap Company, Boston, Mass., is introducing to the electrical trade generally a unique contrivance which, as its name indicates, is to be placed on the usual Edison circuits.

The Franklin Model Shops, 129-131 West Thirty-first street, New York city, Parsell & Weed, proprietors, have issued a unique booklet on model making for electrical, experimental and fine tool work.

Robert L. McOuat, successor to Varney & McOuat, dealers in electrical supplies, Indianapolis, Ind., is the local agent for the Warner Telephone ringers. This apparatus was illustrated and described in a recent issue of the ELECTRICAL REVIEW.

Bevin Brothers Manufacturing Company, East Hampton, Ct., is a large manufacturer of unmounted bells of all styles and sizes for electrical purposes. The company makes special bells for electromobiles, telephone and electric call work.

The McDermid Manufacturing Company, 207 South Canal street, Chicago, Ill., is a large manufacturer of fine sizes of single silk insulated magnet wires, also double silks, single and double cottons, induction coils and wires for special wiring.

Paragon Fan and Motor Company, 572 to 578 First avenue, New York city, has issued bulletin No. 62, illustrating and describing its complete line of the well-known Paragon fan motors and fan motor parts. The bulletin may be obtained free on application.

William Roche, 42 Vesey street, New York, inventor and sole manufacturer of the "New Standard" dry battery, invites all users of dry batteries to make the most rigorous tests in the matter of longevity and efficiency of this battery and compare the results with tests of other batteries.

The Lea Electric Manufacturing Company, Elwood, Ind., will soon have ready for the market a miniature enclosed arc lamp for 110 volts. This lamp will weigh only eight pounds, complete, with shade and inner globe, and will be 17 inches over all. It will take two and one-half amperes of current.

The Cutter Company, Philadelphia, through its London and Paris representatives, Robert W. Blackwell & Company, will make an interesting exhibition of the different types of "I-T-E" circuit breakers at the International Tramways and Light Railway Exhibition, to be held in London in the near future.

The Helios-Upton Company are now operating factories at Philadelphia, Peabody, Mass., and Chicago. This company has the following representatives: Thomas & Betts, 141 Broadway, New York; Badt-Goltz Engineering Company, 1504 Monadnock Block, Chicago, and John Forman, Montreal, Canada.

The Gilchrist Jar Company, 424 Drexel Building, Philadelphia, manufactures machine-made battery jars which are claimed to be superior to the hand blown, as being stronger and more uniform; also the claim is made that the distribution of glass by this process assures the proper annealing and a much stronger jar.

The Columbia Incandescent Lamp Company, St. Louis, Mo., has had a most active season and the shops have been taxed to their full capacity to fill the demand for rapid shipments. By the general indications, as reflected by this company's condition, the demand for incandescent lamps is likely to rule more heavily during this Summer season than in any previous year.

The Ericsson Telephone Company, 296 Broadway, New York, has just issued "Part Four" of its series of illustrated and descriptive literature on Ericsson telephones. In this little pamphlet is given an outline of the Ericsson apparatus as used in Germany, Russia, South America and England; in fact, in nearly all the foreign countries. It will be sent free on application.

The Century Telephone Construction Company, Cleveland, O., the organization of which was announced through these columns some time ago, is now manufacturing telephones, switchboards and accessories. Mr. Burt Hubbell, well-known in the telephone field as having been identified with many large telephone developments within the independent lines, is president of this company.

The Gould Storage Battery Company, through its New York office, 25 West Thirty-third street, is now equipping several interesting battery installations which will be completed in the near future. The Gould battery is being energetically introduced as having several fundamental advantages for electromobiles, central stations and other purposes where the storage of electrical energy is practicable.

The Phoenix Glass Company, 15 Murray street, New York city, is sending to its friends and customers a universal postal card mentioning, in the principal foreign languages, the advantages of its glassware for electrical service. Each postal card contains a cut of the principal types of globes and shades made in glass by this well-known firm. The idea is unique and should result in inquiries for the popular Phœnix products.

The electrical supply house of Frank A. Stewart & Company, 35 North Seventh street, Philadelphia, has rapidly risen to the front as a large distributing centre for high grades of electrical supplies. The company has for general distribution three interesting catalogues of value to electrical people, any one or all of which will be sent upon request. They are as follows: "Lighting," "Telephone" and "Household Supplies."

The Russell-Tomlinson Electric Company, Milford, Ct., has just perfected a new intercommunicating telephone system. The instruments are of the same general type as the Bell central energy system instruments. They are artistically made of mahogany and quartered oak and are claimed to be electrically and mechanically perfect. The instruments are entirely self-contained and connections are made to binding posts on the bottom so that the setting up is most simple.

The Electric Gas Lighting Company, Boston, Mass., is the sole manufacturer of the Samson battery, so well-known throughout the electrical field. This battery is splendidly adapted to portable work, such as gasoline engines, launches, automobiles, slot machines, etc. The company will be glad to send, on request, pamphlets illustrative and descriptive of the many forms of this battery, or catalogues relative to electric gas lighting apparatus, which the company manufactures.

The Michigan Pipe Company, Bay City, Mich., wishes the ELECTRICAL REVIEW to announce that it will be glad to send to inquirers a copy of its new catalogue relative to creosoted wood conduits for underground wires; or this catalogue will be furnished, on application, through the New England agents, F. A. Houdlett & Son, 138 Milk street, Boston. This form of conduit is claimed by the manufacturers to last practically forever, to be easily accessible and to neither gather any moisture nor scratch the cables.

The Michigan Electric Company, Detroit, Mich., operates, in connection with its electrical supply establishment, a manufacturing department devoted entirely to switchboards and panel board construction. The company makes every type of these boards and they are always made with a uniform character of panels, suited respectively to generators, storage batteries, main load and feeders. A number of switchboard installations have recently been completed by this company, most of which are in the middle West, and these installations are among the most successful and satisfactory switchboard equipments yet accomplished in large work. The Michigan Electric Company also maintains a well-equipped shop for all character of electrical repairs, armature winding, testing, model work and special designs.